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Assessment of the NAFO Division 4T southern Gulf of St. Lawrence herring stocks in 1998

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Abstract

The $F_{0.1}$ spring spawner fishing level for 1999 is 18,500t. This estimate is above the 13,000t projected for 1999 from the 1998 assessment. Reported 1998 landings of spring spawners were 15,653t compared to a TAC of 16,500t. Inshore catch rates calculated form the New Brunswick market co-ordinator program in Escuminac and southeast NB indicated a slight decrease in the overall abundance from 1997 to 1998. However, there was an increase in abundance of ages 4, 5, and 7. These catch rates are at the higher levels of the time series. The 1991 year-class is dominant in the population at this time; the incoming 1994 year-class is slightly above average, and age 4+ spring spawner biomass is above average at 86,000t in 1998. The age 4+ fishing mortality has been very close to the target exploitation rate of 24% in recent years. Abundance of herring that spawn during the spring in Chaleur Bay has declined during the last five years and continued to be low in 1998.

The best estimate of the $F_{0.1}$ fall spawner fishing level for 1999 is 60,500t. This level takes into account the tendency to over-estimate age 4 fall spawners. The 1993 year-class, which was estimated last year to be the highest since 1978, was estimated in this assessment to be above average and the fourth highest in the time series. The most recent year-class (1994, 4 year-olds) is now estimated to be the highest in the time series and is 38% of the 400,000t estimated age 4+ biomass in 1998. Without correcting for the tendency to over-estimate four year-olds, the 4+ biomass was the highest in the time series and the $F_{0.1}$ fishing level for 1999 would be 67,500t. Other indicators of fall spawner biomass do not support the estimate that 1998 4+ biomass is the highest in the time series. The acoustic and bottom trawl survey indices are at moderate levels and opinions of abundance expressed during the phone survey of the inshore fleet generally indicated declines in abundance from 1997 to 1998. Inshore catch rates were similar in 1997and 1998, and while not the highest in the time series, were above average. Reported 1998 landings of fall spawners were 43,023t compared to the fall spawner TAC of 54,248t. A major change in the fall fishery in 1998 was the lowest recorded catch (<100t) in the 4T overwintering fishery in 4Vn. Participants in the fishery reported that these low catches were the result of herring being inaccessible to the gear, rather than a problem with abundance. The age 4+ fishing mortalities have been below the target exploitation rate for each year since 1981, except for 1990 and 1995.

Résumé

Le niveau des prises de géniteurs de printemps à $F_{0,1}$ pour 1999 se situe à 18 500 t, soit une estimation supérieure aux 13 000 t projetées pour 1999 dans l'évaluation de 1998. Les débarquements signalés pour 1998 s'élèvent à 15 653 t par rapport à un TAC de 16 500 t. Les taux de capture dans les eaux côtières tirés des données du programme des coordonnateurs du marché du Nouveau-Brunswick, à Escuminac et dans le Sud-Est de la province, indiquent une légère baisse de l'abondance totale entre 1997 et 1998; par contre, l'abondance du hareng de 4, 5 et 7 ans a augmenté. Ce sont là les taux de capture les plus élevés de la série chronologique. La classe d'âge de 1991 est la plus abondante dans la population à ce moment-ci, l'abondance de la classe d'âge de 1994 en recrutement se situe légèrement au-dessus de la moyenne tandis que la biomasse de géniteurs de printemps de 4 ans et plus, atteignant 86 000 t en 1998, s'inscrit au-dessus de la moyenne. La mortalité par pêche du hareng de 4 ans et plus se rapproche du taux d'exploitation ciblé de 24 % au cours des dernières années. L'abondance du hareng qui fraye dans la baie des Chaleurs au printemps a diminué au cours des cinq dernières années; elle continue d'être faible en 1998.

La quantité de 60 500 t est la meilleure estimation du niveau des prises de géniteurs d'automne à $F_{0,1}$ pour 1999, niveau tenant compte de la tendance à surestimer l'abondance des géniteurs d'automne de 4 ans et plus. L'abondance de la classe d'âge de 1993, estimée l'an dernier comme étant la plus forte depuis 1978, est considérée dans la présente évaluation comme étant au-dessus de la moyenne, en étant la quatrième plus élevée de la série chronologique. La classe d'âge la plus récente, soit celle de 1994 (hareng de 4 ans), est maintenant estimée comme étant la plus abondante de la série chronologique, représentant 38 % de la biomasse estimative de hareng de 4 ans et plus de 400 000 t pour 1998. Sans tenir compte de la tendance à surestimer l'abondance du hareng de 4 ans, la biomasse de 4 ans et plus est la plus élevée de la série chronologique et le niveau des prises à $F_{0,1}$ pour 1999 se situe à 67 500 t. D'autres indicateurs de la biomasse de géniteurs d'automne n'étayent pas l'estimation à l'effet que la biomasse de 4 ans et plus en 1998 est la plus élevée de la série chronologique. Les indices obtenus par relevé acoustique et au chalut de fond sont moyens, tandis que les opinions exprimées lors du sondage téléphonique des pêcheurs côtiers indiquent généralement une baisse de l'abondance entre 1997 et 1998. Les taux de capture dans les eaux côtières en 1997 et en 1998 sont semblables; bien qu'ils ne soient pas les plus élevés de la série chronologique, ils s'inscrivent tout de même au-dessus de la moyenne. Les débarquements signalés de géniteurs d'automne en 1998 se situent à 43 023 t par rapport au TAC de 54 248 t. La pêche d'automne en 1998 a été marquée par les plus faibles prises signalées de hareng d'hiver de 4T dans 4Vn, soit <100 t. Les participants à cette pêche sont d'avis que ces prises médiocres sont le résultat de la non-disponibilité du hareng aux engins de pêche employés plutôt que d'une faible abondance. La mortalité par pêche du hareng de 4 ans et plus est inférieure au taux d'exploitation ciblé pour chaque année depuis 1981, sauf en 1990 et 1995.

1. Introduction

This document provides an assessment of population biomass and fishing mortality for spring and fall spawning herring in NAFO 4T based on the 1998 fishery data and research projects.

Key analyses for spring spawners were:

Continued use of the catch rates that combine New Brunswick market co-ordinator (1990-1996), catch monitoring (1997), and dockside monitoring data (1998).

Examination of area-week interaction effects on the multiplicative model used to estimate spring catch rates.

An ADAPT-VPA is used to estimate population biomass using the catch rates described above as the main calibration index.

A new ADAPT-VPA formulation, estimating the ratio of fishing mortality between plus group and next youngest age, rather than forcing the ratio to be 1 as in previous years, was tested.

Inclusion of an acoustic survey abundance index based on strata consistently surveyed from 1994 to 1998.

Biomass indices from acoustic surveys completed by an inshore boat during the 1998 spring gillnet fishery were presented for the first time.

Key analyses for fall spawners were:

A comparison of the ADAPT model for fall spawners using a catch rate index from 1978-1998 and splitting the catch rate into two time series (1978-1991) and (1992-1998) to account for increased use of larger mesh sizes in the gillnet fishery in recent years.

A new ADAPT-VPA formulation, estimating the ratio of fishing mortality between plus group and next youngest age, rather than forcing the ratio to be 1 as in previous years, was tested for fall spawners, as it was for spring spawners.

Examination of area-week interaction effects on the multiplicative model used to estimate fall catch rates.

An examination of the relationship between acoustic data collected during regular fishing activity and catch rates in the Gulf Nova Scotia fall herring fishery are presented for the first time.

Inclusion of an acoustic survey abundance index in the ADAPT-VPA based on strata consistently surveyed from 1994 to 1998.

2. The Fishery

2.1 Landings

Southern Gulf of St. Lawrence (Fig. 1) herring are harvested by an inshore, primarily gillnet fleet, fishing in 4T and a purse seine fleet of six vessels (>65') in 4T and 4Vn. Five small seiners (<65') also participate in the inshore fishery. Unless specifically stated as small seiners, the terms purse seiners or seiners refer to the purse seine fleet with vessels > 65'. Two stocks of herring are harvested in these fisheries. The spring spawning stock spawns before July 1 and the fall spawning stock after July 1. During the spring and fall fishing seasons, seiners are prohibited from fishing in several areas set aside for exclusive fishing by the inshore fleet (Claytor et al 1998a).

Prior to 1967, southern Gulf of St. Lawrence herring were exploited mainly by gillnets and average landings from 1935 to 1966 were 34,000 tonnes. In the mid 60s, a purse seine fishery was introduced and average landings were 166,000 tonnes from 1967 to 1972. Quotas were introduced in 1972 at 166,000 tonnes and reduced to 40,000 tonnes in 1973. Separate quotas for spring and fall spawners began in 1985 (Table 1). Catches of spring and fall spawners combined have been below the TAC since 1988 (Fig. 2).

The spring spawner TAC was exceeded from 1994 to 1996 and was nearly caught in 1997 and 1998 (Fig. 3). The fall spawner TAC has not been exceeded since 1986 (Fig. 3). Since 1981, the inshore fixed gear component has had the majority of the catch of spring and fall spawners (Fig. 4).

Most of the spring spawner inshore catches occur during the spring season in areas 16C and E (Table 2, Fig. 1). Most of the fall spawner inshore catches come from 16B during the fall fishing season (Table 2, Fig. 1).

Spring inshore allocations were exceeded in 1998 but fall inshore catches were about 4,000t below the allocation and seiner catches were about 13,000t below their spring and fall allocation (Table 3). The fall seiner fishery in Chaleur Bay was one of the lowest in recent years, and the seiner catch in 4Vn was very low (52t). This 4Vn catch was far below any other year in which the fishery has occurred (Table 1).

Bait fishery licenses were similar in number in 1998 to 1997 in every province (Fig. 5)

Price in the fall inshore gillnet markets dropped 0.60 cents/lb from 1997 to 1998, while the inshore spring gillnet markets increased by 1.30 cents/lb (Table 4). Prices for the seiner market also dropped 0.60 cents/lb in 1998 (Table 4).

2.2 Industry Input

Industry input for the assessment was acquired during workshops held in November, from a phone survey conducted from December to January, after the fall season, area surveys using inshore fishing boats in the spring in West PEI and southeast New Brunswick, area surveys in the fall using inshore boats in Gulf Nova Scotia and a seiner in Chaleur Bay, and by obtaining summarized comments from seiner captains participating in the 4Vn seiner fishery.

During workshops in 1998, the view of industry was that biomass was increasing, especially in the Magdalen Islands. Spring gillnetters in Chaleur Bay reported continued declines in spring stocks, especially in traditional spawning areas. For the fall, no one noted major increases or decreases in biomass.

The phone survey collects information on the fishery and opinions on abundance trends. The southern Gulf is divided into 8 areas corresponding to the major fisheries (Fig. 6). A subset of active commercial license holders are phoned and asked a series of questions concerning number and size of nets used, frequency of fishing and how the abundance in the current year compares to the previous year and the long term trend (LeBlanc and LeBlanc 1996).

In 1998, 128 spring gillnetters and 167 fall gillnetters responded out of a total of 2400 active licenses in spring and fall (Tables 5, 6).

Concerning abundance trends, spring gillnetters in the areas with the most landings, Escuminac, Southeast New Brunswick, Magdalen Islands, and West PEI felt abundance declined from 1997 to 1998 (Fig. 7). In the fall, except for the Magdalen Islands, survey respondents indicated that abundance was either the same or less in 1998 compared to 1997 (Fig. 8).

In 1998, landings in the 4T overwintering fishery in 4Vn were the lowest on record. Industry comments were that the fish were inaccessible to the gear rather than that there was a problem with abundance.

Summarized comments on the 4Vn purse seine fishery from the Gulf Seiner Association were as follows:

Date	Comment
Nov 1-7	Fish were on the bottom in 25-35 fathoms, impossible to catch, Nov. 2 surface water 9.1 C
Nov. 8-14	Similar picture to previous week, Nov. 13 one try in Rocky Bay, released 50t, because of small fish, the vast majority, however, were big fish. During the remaining of the night fish were on the bottom. Surface water 8.2 C
Nov 15-21	Nov. 17 one try in Aspy Bay, the amount of fish on the sonar, indicated that a catch of about 100t would be expected, but fish were down on the bottom and we were only able to catch 15t. Other nights it was impossible to seine as fish were on the bottom. During this week most of the fish were between Cape Egmont and Rocky Bay. Fish would come up at midnight but not enough to be caught.
Nov. 22-28	Tried twice, but same scenario. Small school on bottom in Aspy Bay. Surface water 5 C
General	Searched in shallow water to deeper water every night approximately 12 miles from shore, fish on bottom.

2.3 Fishing Methods

The fall and spring gillnet fisheries differ in the type of fishing and size of nets. For example, most spring gillnets are either 2 1/4" to 2 1/2" (Fig. 9). Most spring nets are 14 to 19 fathoms long (Table 7). At one time, 2 5/8" was the most commonly used mesh size throughout the southern Gulf fall inshore fishery (Fig. 10). Recently, in Escuminac, Nova Scotia, and West PEI there has been an increasing number of individuals using 2 3/4" or 2 7/8" mesh and is the reason the for the decline in the percentage of gillnetters using 2 5/8" mesh (Fig. 10). Most nets are 14 to 18 fathoms long (Table 7).

Type of fishing differs between the two seasons. For example, in the spring almost all nets are fished by anchoring overnight and hauling the next morning. In the fall, spawning schools are searched for, and nets are set when a school of sufficient size is found. In Escuminac, Quebec, Magdalen Islands, and Acadian Peninsula nets are fished with one end tied to the boat and the other anchored. In other areas, nets are anchored at both ends and two or more strings may be set (Table 8).

2.4 Fishing Effort

The number of nets used in the spring and fall fisheries, estimated by the phone survey, is an important part of the effort measurement used to formulate abundance indices for ADAPT-VPA models.

Numbers of nets have been estimated for the entire southern Gulf since 1978. In the late 1970s and early 1980s, about twice as many nets were used in the fall fishery as in recent years (Table 9). Since 1986, the number of nets has been estimated for statistical districts accounting for most of the landings. These estimates indicate that until recently fewer nets are used in the Acadian Peninsula (Statistical Districts 65-67, Fig. 6) than other areas in the fall (Table 10). Recently, the numbers of nets used in other areas has declined and are now equal or only slightly above the numbers used in the Acadian Peninsula (Table 10).

Numbers of nets used in the spring fishery declined compared to numbers used during the late 1970s and early 1980s with the exception of 1988 (Table 9). Numbers of nets in the spring have

been estimated by area since 1986 and indicate that for the two major fishing areas, that fewer nets are used in Escuminac than southeast New Brunswick, except for 1998 (Table 11). At workshops, however, it was reported that the depth of nets in Escuminac is greater than in southeast New Brunswick.

2.5 Catch and Weight-at-age matrices

Separate spring and fall spawner catch and weight-at-age matrices were developed for all 4T herring including those caught by purse seiners in 4Vn. These were derived using age-length keys and length-weight relationships for each principal fishing area and season. In some cases, fishing activity within an area differed through the season and separate keys and relationships were developed for those cases. For example, the bait fishery in 4Tmn during July had a higher proportion of spring spawners than the roe fishery during August and September and a separate key was used. The keys, samples, spawning group assignment, and numbers of fish examined in detail in each of these is described in Table 12. When the number of fish sampled for detailed analysis was < 30, the overall length-weight relationship and age-length key nearest in gear, geography, and time that contained sufficient samples was used to estimate the catch-at-age. Spawning group assignment was made as in previous assessments using a gonadosomatic index (GSI) (McQuinn 1989) to assign maturity stage and a monthly key that linked maturity stage and month to spawning group (Cleary et al. 1982).

The distribution of sampling relative to daily catches for each key and relationship is in Tables 13-25. This information is provided so that the level of sampling relative to the amount and timing of the catch can be evaluated. It also provides a method for comparing run-timing among years, as this information is provided in previous assessments.

Catches of fall spawners were dominated by the 1992 (age 6) year-class for inshore and seiner fleets in 1998 (Fig. 11). The 1993 (age 5) and 1994 (age 4) year-classes were the next most important parts of the catch in both fleets for 1998. Low numbers of the 1989 (age 9) and the 1991 (age 7) year-classes continue to indicate the below average size of these year-classes. The once dominant 1987 (age 11) and 1988 (age 10) year-classes no longer contribute appreciably to the fishery (Fig. 11, Tables 26, 28).

Catches of spring spawners were dominated by the 1991 year-class (age 7 in 1998) as they were in 1997 and 1996 (Fig. 12). Low numbers of the 1990 (age 8) and the 1992 (age 6) year-classes continued to indicate that these year-classes are below average. The very large 1988 (age 10) year-class no longer contributes appreciably to the fishery (Fig. 12, Tables 29, 31).

2.6 Aging Consistency Test

A reference collection was selected from herring otolith samples collected from 1990 to 1997. This collection was selected so that there was approximately equal representation from all times, areas, gears, and survey types sampled during the year. There was no effort to ensure that otoliths were of a particular clarity; but otoliths that had not been aged because of problems in their storage media were excluded. The reference collection contained approximately 4,000 otolith pairs.

To ensure that all ages were represented in this test, the ages were divided into four groups: 0 to 2, 3 to 5, 6 to 8, and 9 to 11+ with 11+ being composed of all ages ≥ 11.

The average coefficient of variation (cv) for this data set was 2.2%. (Table 32). The percent agreement overall was 81%.

There was no bias in the test data (Fig. 13).

2.7 Mean weights

Mean weights at age for fall spawners have been generally less since 1990 than they were during the late 1980s and early 1990s (Tables 27, 28; Fig. 14). For fall spawners, herring caught by the

purse seiners are smaller at age than those caught by inshore gear (Fig. 14). Most fall spawners caught by the inshore are on spawning beds and are heavier at age because their gonads are more ripe.

Mean weights at age for spring spawners are generally less in recent years than they were during the late 1980s and early 1990s (Tables 30, 31; Fig. 15). Spring spawning herring caught by purse seiners are larger than those caught by the inshore fleet. Purse seiners catch most of their spring spawners during the fall, while most inshore spring spawners are caught during the fall season. The greater weight at age for the purse seine spring spawner catch could be the result of a season's growth more than making up for the weight loss of gonads during spawning of the fish caught in the spring by the inshore fleet. The declines observed in recent years seem to have stabilized or slightly reversed for both spawning groups (Figs. 14, 15).

3. Spring Spawner Abundance Indices

3.1 Commercial Fishery CUE Index

Spring spawner abundance indices were derived by combining two data sets. The first consists of dockside monitoring in Escuminac and Southeast New Brunswick by the Province of New Brunswick from 1990 to 1996. The second consists of the dockside monitoring conducted throughout the 4T spring fishery in 1997 and 1998 as directed by the Herring Management Plan. The rationale and method for combining and using these data sets were described in last year's assessment (Claytor et al. 1998a).

Effort was estimated as the number of fishers fishing each day multiplied by the average number of nets/fisher as estimated from the phone survey for each area (Table 11). Thus, the unit of measurement for effort is nets/day.

A multiplicative model with 10 day-period, area (Escuminac, Southeast New Brunswick), and year effects was used to estimate an annual abundance index using the dockside monitoring data from 1990 to 1998. The model was significant ($r2 = 0.33$, $p = 0.0001$) (Table 33). From the residual, and DFITTS plots, there are no indications of violation of model assumptions nor influential points (Fig. 16). Catch rates forming the index are kg/net/day (Fig. 17).

The time period used was April 20 to June 29, however, about 30% of the cells were empty (Table 34). The analysis was re-run using only ten-day periods, 3-6, reducing the number of cells to 13% (Table 34). The catch rates formed using these two analyses were nearly identical and the original catch rates using ten-day perioeds 2-7 were retained (Fig. 18).

The catch rate index used as an abundance index for ages 4-10 and years 1978 to 1997 in units of numbers/net/day was derived as follows:

Effort = Catch biomass from inshore gear/ CUE fixed gear

Abundance index = Catch numbers from inshore gear/ Effort.

This index (Table 35) was used to calibrate or tune the ADAPT-VPA population model used to estimate biomass.

There are differences in timing between the two areas (Table 34) forming the catch rate index. Because of these differences, there was potential for a greater proportion of the variation to be explained by including area by week interaction effects in the model. Including these effects in the model explained about 41% of the variation (Table 36), compared to 33% for the model without interaction (not shown). As a result a second catch rate index, using weeks 2-7 was calculated and used to estimate biomass using the ADAPT-VPA population model.

3.2 Phone Survey

Responses to the phone survey indicate that in Escuminac and Southeast New Brunswick, herring abundance was felt to be less in 1998 than in 1997 (Fig. 7). These are the two areas used to formulate the catch rate abundance index described above. In West PEI and the Magdalen

Islands, the other major spring areas, abundance was also thought to have decreased from 1997 to 1998 (Fig. 7).

3.3 Acoustic Survey Index

For the first time, a standard abundance index from the annual acoustic survey is used in an ADAPT-VPA formulation. This index includes Chaleur-Miscou strata surveyed consistently from 1994 to 1998. This time period corresponds to when the survey began with the F. Creed and when all transects were covered at night (Table 37). Methods and detailed results from these surveys are provided in (LeBlanc et al. 1993; LeBlanc and Dale 1994; LeBlanc et al. 1995; LeBlanc and Dale 1996; Claytor et al. 1997, 1998a) for 1990 to 1997 and in Appendix 1a-e for 1998.

In 1998, the acoustic survey covered two major areas of the 4T stock, Chaleur - Miscou (Fig. 19) and Cape Breton (Fig. 20). Sampling to determine biological characteristics and to estimate target strength was carried out wherever major concentrations were observed (Fig. 21) .

In general, 50 to 100% of the fall spawners have been observed in Chaleur-Miscou strata (Table 38), including years when North PEI and Cape Breton, as well as, Chaleur Miscou have been surveyed.

In contrast, the percentage of spring spawners found in Chaleur-Miscou strata has varied from 80 to 100% in all years, including years when North PEI, and/or Cape Breton, as well as Chaleur-Miscou strata were surveyed (Table 38).

The biomass index for combined spring and fall spawners declined from 1997 to 1998 for all strata and strata consistently surveyed (Fig. 22). The 1998 index, however, was still slightly higher than the previous lows in 1991 and 1995 (Fig. 22).

The acoustic survey catch-at-age (Table 39) was estimated using samples collected from each strata. The catch-at-age for the survey was weighted by the signal strength in each strata. The numbers at age, scaled to the catch rate index formed the age dis-aggregated abundance index from this survey.

3.4 Bottom Trawl Survey

The annual bottom trawl survey provides a third abundance index of 4T herring throughout the southern Gulf of St. Lawrence. The survey has occurred consistently during the month of September from 1971 to 1998. During the 1990s herring have been found primarily along the north coast of Prince Edward Island and through the Northumberland Strait (Fig. 23). The abundance index from this survey indicates the same general low to high shift in population level as the Fall CUE index (Figs. 24, 48) and has ranged from 24,000 to 100,000 t from 1984 to 1998, with the exception of 1996 which was 7700 t. These estimates are higher compared to 1971 to 1983 when the stock was at a low level and estimates ranged from 300 to 33,000 t (Fig. 24). These comparisons have been made excluding strata 401-403 which were added to the survey in 1985.

Detailed herring samples to construct a catch-at-age by spawning group have been collected since 1994 and are compared to the ADAPT-VPA results in the assessment results.

4. Spring Spawner Assessment

4.1 Estimation of Stock Parameters

4.1.1 CUE Index

A new formulation of the ADAPT model was tested this year. The difference between this model and the one used last year was that the ratio of the fishing mortality between the 11+ group and 10 year olds was estimated, rather than forced to be 1. The FRATIO function of ADAPT V 2.1 (Gavaris 1999) was used to estimate the fishing mortality ratio. The model used last year was

designated as F-OLD. All other aspects of the model were the same as last year. Calibration ages were 4-10, calibration years were 1990 to 1998.

Parameter estimates from the F-OLD formulation had cv's ranging from 0.35 to 0.49 for population numbers and from 0.15 to 0.17 for catchability coefficients, similar to last year. The highest parameter correlations were < 0.40 (Table 40). Bias was 12.5%, similar to last year. Annual residuals were within +/- 1.5, with trends for ages 4, 7, and 10. Ages 4, 7, and 10 had annual trends in these residuals. All residuals for 1990 were negative except for age 4 (Fig. 25). These patterns do not indicate major violation in model assumptions.

Parameter estimates from the FRATIO formulation had cv's ranging from 0.35 to 0.49 for population numbers, 0.49 for the fishing mortality ratio, and 0.16 to 0.20 for the catchability coefficients (Table 41). These cv's were similar to those for the F-OLD formulation (Table 40). Relative bias was 13.2% (Table 41). The highest parameter correlations were 0.45 to 0.55 for the oldest ages and the FRATIO estimate (Table 42). The remainder of the parameter correlations were < 0.40 (Table 42). Annual residuals were within +/- 1.5 with trends for ages 4, 7, and 10. The two methods provided similar results in these respects. All residuals for 1990 were negative except for age 4 (Fig. 26). These patterns, do not indicate major violation in model assumptions and were the same as those for F-OLD (Fig. 25).

A retrospective comparison of the results from the two formulations indicates a similar pattern for each model for the last three years. However, when the fourth year is deleted the FRATIO model performs better than the F-OLD model (Fig. 27). An age by age retrospective comparison of these models indicates similar results except for the older ages (7-11+). For these ages the FRATIO model performs better (Fig. 28).

A comparison of population numbers by age between the two models indicates very similar estimates for each age. Differences are most noticeable for the two oldest ages (10, 11+) and the F-OLD formulation provides the higher estimate of the two for oldest ages (Fig. 29). These ages, however, contribute little to the fishery.

Results from the two models were similar. The retospective analysis indicates the FRATIO method was somewhat better for the older ages; residual patterns, cv's, and parameter correlations were similar with the two models. The FRATIO model was used to estimate biomass because of the better retrospective analysis and the ability to estimate rather than apply an assumed value for the fishing mortality ratio between 11+ and age 10.

4.1.2 Acoustic and CUE Indices

A second ADAPT formulation using the acoustic index as well as the commercial CUE was used to estimate population numbers, biomass, and fishing mortality. The FRATIO model was used for this estimation. The acoustic index calibrated ages 4-8.

The relative bias from this analysis was 11.9%, slightly less than using the CUE index alone and cv's for population numbers ranged from 0.35 to 0.46, slightly less than using CUE alone. The f ratio between age 10 and 11+ was 1.68 (Table 43) compared to 1.5 using the CUE index alone (Table 41). The highest parameter correlations were also similar ranging from 0.42 to 0.52 (Table 44).

Residual patterns showed no trends except for age 8 (Fig. 30).

Retrospective analysis of the population biomass indicate a similarity between estimates based on data up to 1997 and 1998, but estimates based on data only to 1996 are lower (Fig. 31). Because the acoustic index includes only years 1994-1998, stability for more than two years in the past is not expected. Similar patterns are shown for age by age retrospectives (Fig. 32).

A comparison of numbers estimated at each age using the CUE index alone and with the acoustic index indicate similar estimates for the two methods (Fig. 33). Estimates for 5+ biomass in 1999 are similar for both analyses but the CUE index alone estimated lower biomass from 1996 to 1998

(Fig. 34). Both analyses indicate the same relative year-class strengths; the combined acoustic and CUE model estimates the 1991 year-class as more numerous than the model with CUE as the only calibration index, but the 1994 year-class is estimated higher using the CUE index alone (Fig. 34).

5.2 Spring Spawner - Assessment Results

5.2.1 CUE Index

Spring spawner 1998 4+ biomass was estimated at about 86,000 tonnes and 5+ biomass at about 60,000 tonnes (Table 45). These estimates are higher than the 71,000 tonnes estimated for 4+ biomass and 52,000 tonnes for 5+ biomass predicted for 1998 last year (Fig. 35). The biggest changes are an increased estimate for the 1991 year-class and slightly higher estimates for the 1993 year-class (Fig. 35).

This year's analysis continues to indicate that the 1992 year-class, (age 6 in 1998) was one of the poorest since 1978. The 1993 and 1994 year-classes are slightly above average but are about 50% of the large 1991 year-class which has supported the fishery in the last few years (Fig. 36).

Estimates of 4+ numbers using the interaction and non-interaction models were very similar (Fig. 37) and indicate that using the non-interaction model is appropriate and is used throughout the assessment to estimate spring spawner population abundance.

Results using the CUE index indicate that weighted 4+ fishing mortality has been under the target 24% in recent years (Fig. 38). The relationship between 4+ fishing mortality and effort over the levels of effort observed is significantly linear, though the influence of the 1994 data point has not been checked (Fig. 39). Fishing mortalities for the 1990 cohort and earlier sum to 2.0 or greater, indicating convergence for these parts of the matrix (Table 46).

5.2.2 Acoustic and CUE Indices

Spring spawner 4+ biomass was estimated at about 88,000 tonnes and 5+ biomass at about 70,000 tonnes (Table 47). These estimates are higher than the 86,000 tonnes estimated for 4+ biomass and 60,000 tonnes for 5+ biomass estimated using CUE alone (Fig. 34).

This analysis also indicates that the 1992 year-class, (age 6 I 1998) was one of the poorest since 1978. The 1993 and 1994 year-classes are slightly above average but are about 50% of the large 1991 year-class which has supported the fishery in the last few years (Fig. 46).

5.2.3 Age structure comparisons

Catch-at-age from experimental nets fished during the spring fishery, from roe-on-kelp experiments in Escuminac, the September bottom trawl survey, and January bottom trawl surveys was estimated and compared to the population age structure estimated using ADAPT-VPA models.

During the spring fishery, acoustic data were collected by a fishing boat from southeast New Brunswick which conducted surveys, and one fishing boat from western PEI which collected data during regular fishing activity (Appendix 2a). In total, 7 surveys were completed and biomass estimates from these surveys range from 34 to 1100 t (Appendix 2b). Biomass estimates were made following procedures outlined in the 1998 assessment documents (Clay and Claytor 1998, Claytor et a. 1998ab).

During these surveys, experimental gillnets were fished to provide samples for determining target strength relationships, data for estimating recruitment strength, and data for estimating mesh size selectivity. The nets consisted of panels of different mesh sizes (1 ½", 2", 2 ¼", 2 3/8", 2 ½", 2 ¾"). Each panel was about 8 feet long, and equivalent to 100 meshes of 2 ¼" meshes deep; panels were spread 3 feet apart. Sampling from these panels was identical to that in the commercial fishery, in that 2 fish from each 0.5 cm length group were retained for detailed sampling. Ages from these samples indicated that age 7 were dominant in the population and

may be caught in all mesh sizes, though are most likely caught at sizes between 2 ¼" and 2 ½" (Fig. 40).

Catch-at-age from the September and January bottom trawl surveys was estimated following the same procedures as those used for groundfish catch-at-age. Spring spawner numbers at age were relatively low compared to fall spawners in the September survey. Spring spawners in the catch at age were predominately juveniles (Fig. 41). Dominant year classes in the spring spawners from the January bottom trawl survey catch-at-age varied annually (Fig. 42).

Examination of the Escuminac roe-on-kelp ages indicates that the dominant age 7s in the fishery were also dominant in the roe-on-kelp trap at the time of the fishery, but that younger ages predominate later in the season (Fig. 43).

A comparison of the age structure from the population model based on the fishery index to the age structure derived independently from the acoustic survey indicates general agreement between these two estimates (Fig. 44) In addition, sampling from a trapnet designed to capture spawners for a roe-on-kelp project in Escuminac, shows a similar age structure to the acoustic and population estimates from 1996 to 1998 (Fig. 44). Age structure of the September survey using a bottom trawl and the experimental nets show a similar age structure to the 4T population estimated using ADAPT but the January survey age structure is not very similar to the 4T ADAPT population age structure (Fig. 45).

5.3 Spring Spawner - Future Prospects

Projections for 1999 and 2000 were made by taking the 1998 beginning of the year biomass at age and subtracting losses from natural mortality and fishing to determine expected beginning of the year numbers for each of these years as in previous assessments (Claytor et al. 1998a). The target fishing mortality of $F_{0.1}$=0.44 (fully recruited age) was applied to these numbers to determine the $F_{0.1}$ fishing level.

Input parameters were partial recruitment at age, average weights-at-age, and recruitment at ages 2, 3, and 4. Partial recruitment values were derived from average fishing mortalities from 1996 to 1998. Age 2 ,3 and 4 recruitments were the geometric mean from 1978 to 1995 for age 2 and to 1996 for age 3 and to 1997 for age 4. The $F_{0.1}$ fishing level for 1999 is 18,600t and for 2000 16,000t (Table 48).

6. Fall Spawner Abundance Indices

6.1 Commercial Fishery CUE Index

The principal fall spawner abundance index is the catch per unit effort (CUE) from the fall season gillnet fishery. The CUE is defined as catch kg/nets/trip/day. The catch information comes from purchase slips and dockside monitoring. Effort information consists of trips from purchase slip and dockside monitoring records and the number of nets/trip is estimated from a phone survey of active gillnetters. The number of nets per trip used in the principal landing areas has been estimated by statistical district since 1986 (Table 10) and was used to derive the index for those years. Prior to 1986, the average number of nets for the combined areas of the southern Gulf of St. Lawrence was used (Table 9). Methods for estimating these indices are described in LeBlanc and LeBlanc (1996).

A multiplicative model with year, district, and 10-day periods was used to estimate an abundance index for each fall since 1978. This model was identical to those used in past assessments. The model was statistically significant ($p<0.0001$, $r2 = 0.59$) (Table 49). From the residual, and DFITTS plots, there are no indications of violation of model assumptions nor influential points (Fig.47).

The results indicate catch rates in 1998 were above those for 1995 and 1996 but very similar to those in 1997 (Fig. 48). Effort levels were similar to those in the early 1980s and below the high

levels in 1987 and 1990 (Fig. 48). Analyses completed in the assessment of the 1996 fishery indicated that catch rates were independent of effort (Claytor et al. 1997).

The catch rate index used as an abundance index for ages 4-10 and years 1978 to 1997 in units of numbers/net/trip/day was derived as follows:

Effort = Catch biomass from inshore gear/ CUE fixed gear

Abundance index = Catch numbers inshore gear/ Effort.

This index (Table 50) was used to calibrate or tune the ADAPT-VPA population model used to estimate biomass.

Interaction between area and week effects were significant but explained less than an additional 5% of the variation (Table 51) and so the non-interaction model was used for all subsequent analyses.

6.2 Acoustic Survey

An abundance index from the acoustic survey (Table 50) was derived which included only those strata consistently surveyed from 1994 to 1998, as was done for the spring.

3.4 Phone survey

The phone survey provides a fourth index of abundance (including the bottom trawl survey discussed above) for fall spawners in the southern Gulf of St. Lawrence. During the survey gillnetters are asked to compare abundance in the current year to last year and overall. In the fall, survey respondents indicated that abundance was either the same or less in 1998 compared to 1997 (Fig. 8).

5.3 Bottom Trawl Survey

Bottom trawl survey results are reported for spring and fall spawners combined (Figs. 23, 24) and are reported in section 3.4 on spring spawners.

6. Fall Spawner Assessment

6.1 Estimation of Stock Parameters

6.1.1 CUE Index

Last year a new ADAPT formulation for the estimation of fall spawners was developed and accepted that incorporated the change towards a larger mesh size that has occurred in the 4T fall gillnet fishery from 1992 to 1998. This change was incorporated into the assessment by splitting the CUE index into two parts. The first part was from 1978 to 1991 and covered the period when most of the gillnetters used 2 5/8" mesh. The second part was from 1992 to the present and covered the period when gillnetters in several areas of 4T began to use larger mesh size. The first step in the analysis of this year's data was to determine if the poor residual fit for 4 year olds still applied and if the new model splitting the index was still the most appropriate. In each of the models described below, calibration for the CUE index was for ages 4-10.

The first step in testing the model was to add 1998 to the CUE index has in previous assessments when the CUE was not split and was considered as one time series from 1978 to 1998. This ADAPT run was completed using the F-OLD method as in previous assessments. While cv's and parameter correlations were acceptable (Table 52), the residuals for 4 year olds still exhibited the same pattern which caused concerns in last year's assessment (Fig. 49). Therefore, the model using the split CUE index was used to calibrate ADAPT population estimates for this assessment.

As for the spring, a comparison between the F-OLD and FRATIO models was made. Using F-OLD, cv's ranged from 0.29 to 0.44 for population number parameters and relative bias ranged from 3.5 to 10.4% (Table 53). The highest parameter correlations were 0.35 to 0.42 but most were < 0.3 (Table 53). Residual patterns were much improved over those for the single CUE

model (Fig. 50). These results indicated that the split CUE model was the most appropriate of those tried.

Using the FRATIO method, cv's ranged from 0.33 to 0.43 for population parameters and relative bias ranged from 5.2 to 10.4% (Table 54). The FRATIO was estimated as 1.23 (Table 54). Parameter correlations were > 0.5 at the oldest age but the remaining correlations were all < 0.30 (Table 55). Residual patterns were similar to those for F-OLD (Fig. 51).

A retrospective analysis of both models indicated greater stability for the FRATIO model (Fig. 52). The difference in estimated numbers was less from year to year using the FRATIO compared to the F-OLD method. This effect was primarily observed in the older ages (Fig. 53).

Estimated population numbers were similar for both methods except that F-OLD provided higher population estimates for 11+ (Fig. 54).

6.1.2 Acoustic and CUE Index

The acoustic index calibrating ages 4-9 was combined with the CUE index calibrating ages 4-10 and the FRATIO method was used to estimate population numbers. The cv's for the population parameter estimates ranged from 0.29 to 0.38 and the relative bias ranged from 4.9 to 8.3%. The f ratio was estimated as 1.23 (Table 56). The cv's and bias estimates are less than for the CUE index alone. The highest parameter correlations were from 0.43 to 0.66 on the oldest ages but most were less than 0.30 (Table 57).

Residuals for the acoustic index were within +/- 1.5. Ages 5, 6, and 7 had a declining trend in the last three yeas but other ages were well balanced (Fig. 55).

Population numbers estimated using the acoustic and CUE indices in the FRATIO model were generally lower than those using only the CUE index. The exception was a similarity in 11+ numbers for both models (Fig. 56).

6.2 Fall - Assessment Results

6.2.1 CUE index

Fall spawner 1998 4+ biomass, using the split CUE model, is about 400,000t and 5+ biomass is about 250,000t (Table 58).

Results of the split CUE analysis indicates that the 1994 year-class is the largest observed since 1978. Three of the last four year-classes are estimated to be above average (Fig. 57). The FRATIO and F-OLD methods provide similar 5+ biomass estimates (fig. 58). The 1998 projection based on last year's assessment was higher than the 1998 estimate provided with the updated information. The 1999 projection based on this year's analysis is above the projection for 1999 based on last year's assessment (Fig. 58).

Last year, a precautionary approach was advised, because of the high estimate of 4 year-olds and the large percentage of biomass accounted for by that group and the new assessment model. The analysis using this year's data provides an estimate of this year-class that is about 5/8 that estimated last year. This supports the precautionary approach applied last year (Fig. 58). It also implies that the same consideration might be necessary for 1999.

Results using the single CUE ADAPT model indicate weighted 4+ fishing mortalities have been below the 0.25 target or 20% exploitation rate each year since 1981, except 1990 and 1995 (Fig. 59).

The fishing mortalities summed along the cohorts is close to 2 for years to 1989 and then drops below 1.5 for all subsequent years (Table 59) indicating that this portion of the matrix has converged.

Fishing mortality is significantly correlated with effort (Fig. 60).

6.2.2 Age structure comparisons

Catch-at-age from experimental nets fished during the fall Gulf Nova Scotia fishery, the September bottom trawl survey, and January bottom trawl surveys were estimated and compared to the population age structure estimated using ADAPT-VPA models.

During the fall fishery, acoustic data were collected by two inshore fishing boats from Gulf Nova Scotia during regular fishing activity (Appendix 3a). This acoustic data collection is part of a larger study to investigate methods for estimating local abundance and includes purse seine vessels which have been collecting data since 1995 (Appendix 3b).

During the Gulf Nova Scotia acoustic data collection, experimental gillnets were fished to provide samples for determining target strength relationships, data for estimating recruitment strength, and data for estimating mesh size selectivity. The nets consisted of panels of different mesh sizes. These sizes were 1 ½", 2", 2 ¼", 2 ½", 2 5/8", and 2 ¾". Each panel was about 8 feet long by 100 meshes of 2" mesh and was separated by 3 feet. Sampling from these panels was identical to that in the commercial fishery, in that 2 fish from each 0.5 cm length group were retained for detailed samples. Ages from these samples, considering the selectivity patterns expected at each mesh, indicate that fish from the 1993 year-class which were previously estimated to be the most abundant year-class since 1978 are not as abundant as the 1992 or 1990 year-class (Fig. 61). Relative abundance of other year-classes are as expected from the sampling of the fishery. The incoming year-class (age 4, 1994 year-class) appears to be at least above average (Fig. 61).

Catch-at-age from the September and January bottom trawl surveys were estimated following the same procedures as those used for groundfish catch-at-age from these surveys. Numbers at age from the September survey also indicate that the 1993 year-class is not as abundant as estimated in last year's assessment but that the 1994 year-class is at least above average (Fig. 62). Numbers-at-age from the January bottom trawl survey have few similarities among the various areas surveyed (Fig. 63) which were usually located north of Cape North, Aspy Bay, and south of Cape Smoky (Claytor and LeBlanc 1998).

A comparison of the age structure estimated using the population model based on the fishery index to the age structure derived independently from the acoustic survey indicates general agreement between these two estimates (Fig. 64). There are similarities in the age structures estimated from the population model, the commercial fishery, and the experimental nets. The higher proportion of age 4s in the population compared to the commercial catch are a function of the partial recruitment of this age to the gillnets used in the inshore fishery (Fig. 64). Age structure of the September bottom trawl survey show a similar age structure to the 4T population estimated using ADAPT but the January survey is not very similar to the 4T age structure (Fig. 65).

6.2.3 Acoustic and CUE Index

Including the acoustic index in the model provides a much lower biomass estimate for recent years than using the CUE index alone (Fig. 66). The 1998 4+ biomass estimate is 200,000 t while that for 5+ biomass is 160,000 (Fig. 66). The estimate of the last three year-classes is much less when the acoustic survey is added to the model (Fig. 66).

There is a retrospective pattern in thin model (Fig. 67), most noticeable for ages 4, 9, 10, and 11 (Fig. 68).

With the acoustic index in the model, three of the last four year-classes are still above average but the 1994 year-class is only average (Fig. 69). The 1994 year-class was the largest since 1978 when the split CUE index was used as the calibration index (Fig. 57).

As a result of this retrospective pattern and because of the short time series of the acoustic survey, projections were made using the results from the split CUE model. The results from the model that included the acoustic survey support the need for a precautionary approach for 1999.

6.3 Fall - Future Prospects

As for spring spawners, projections for 1999 and 2000 were made by taking the beginning of the year biomass by age and subtracting losses from natural mortality and fishing to determine expected beginning of the year numbers for each of these years as in previous assessments (Claytor et al. 1997). The target fishing mortality of $F_{0.1}$=0.30 (fully recruited) was applied to these numbers to determine the $F_{0.1}$ fishing level.

Input parameters were partial recruitment by age, average weights-at-age, and recruitments at ages 2, 3, and 4. Partial recruitment values were derived from average fishing mortalities from 1996 to 1998. Age 2, 3, and 4 recruitments were the geometric mean for 1978 to 1995 for age 2, to 1996 for age 3, and to 1997 for age 4. The $F_{0.1}$ fishing level for 1999 is 67,500t and for 2000 is 63,000t (Table 60).

A retrospective projection was done using the updated population estimate for 1997 to determine what the $F_{0.1}$ level would have been for 1998. The $F_{0.1}$ level for this updated version is 63,000 t. The $F_{0.1}$ level estimated from last year's assessment was 66,000 t but was reduced to 60,000 t because of precautionary considerations (Table 61).

If the age 4's in this assessment are over-estimated to the same extent that they were last year, the estimated $F_{0.1}$ level for 1999 would be 60,500 t (Table 62).

7. Area Projects – Spring and Fall

Area projects combining the collection of acoustic data during surveys and fishing, combined with the fishing of experimental nets began in the spring fishery for the first time in 1998. These data are just starting to be analyzed. Preliminary results indicate that biomass estimates can be obtained for spring schools using surveys and that in general, spring spawning schools are smaller than those in the fall. Spring schools also occur over a broader area than fall spawning schools and that the most appropriate method for surveying and estimating spring spawning schools has not yet been determined. The projects undertaken in the Northumberland Strait are being repeated in 1999 and a new project in the Magdalen Islands was begun in 1999.

Area projects in the fall have a longer history, and data have been collected from purse seiners since 1995. Inshore projects began in 1996 with two boats from Chaleur Bay, expanded in 1997 to 6 boats, 2 each from Escuminac, West PEI, and Gulf Nova Scotia, and in 1998 two boats from Gulf Nova Scotia participated (Claytor et al. 1998b). To date preliminary maps of biomass densities have been made for all projects.

Biomass estimates have been obtained using the data collected during regular fishing activity by one of the 1997 Gulf Nova Scotia inshore boats. These estimates were made using kriging and the arithmetic average. For two of the days, estimates were also obtained using inverse distance weighting and natural neighbor analysis (Appendix 3c). Differences between the arithmetic and kriging estimates averaged –13%, so that the kriging estimates were on average less than the arithmetic averages. Data points in these cases consisted of the average density estimates along a 100m fishing track. The methods for partitioning the fishing track and converting acoustic signal to density are described in (Clay and Claytor 1998, and Claytor et al. 1998b).

The relationship between landings and the biomass estimates obtained by kriging has been examined in both arithmetic and logarithmic scales. These indicate that for the individual boat collecting the data landings are not linearly related to biomass and catches equal to the nightly limit (7,000 kg) can be caught even on small schools. These landings would be equivalent to catch rates for this individual boat because the same number of nets was used each night, and each night's fishing consisted of one trip. However, when schools are above a threshold size, the nightly limit was regularly caught by this boat (Appendix 3d). Alternatively, when the entire Gulf

Nova Scotia fleet was considered, the relationship between catch rates and biomass indices was significantly linear in the logarithmic scale (Appendix 3e). There was, however, some indication that this relationship may also be non-linear. These relationships need additional investigation because a linear relationship between catch rate and abundance is one of the key assumptions in the ADAPT-VPA model used to assess this stock.

An exploitation index can be estimated from these data by dividing the catch for the Gulf Nova Scotia fleet by the biomass index obtained by kriging. This index compared over time with the biomass index over time provides an indication of the abundance trends and exploitation rates over the fishing season. These trends indicate three peaks in exploitation rate, one each at the beginning and end of the season and one near the end of the season just prior to the peak biomass estimates (Appendix 3f). The two highest peaks in biomass occur at the end of the season (Appendix 3f). These results imply that there is a 6-10 day period between peaks in biomass and that the greatest exploitation rates occur at the lowest biomass.

An examination of the relationship between exploitation and biomass indices indicates there is a significant inverse linear relationship between the log of the exploitation rate and biomass index (Appendix 3g). This relationship indicates that the highest exploitation rates consistently occur on the smallest schools. A management objective identified for herring stocks is to equalize exploitation rate in time and space. Reducing exploitation rates when schools are small is an important management problem to solve in this fishery.

8. Discussion

Estimates of 4+ spring spawner biomass peaked in 1995, when the 1991 year-class, that was the largest on record, entered the fishery (Fig. 36). This year-class has been supporting the fishery since it first appeared in 1995. The 1992 year-class was among the lowest since 1978 but the two most recently estimated year-classes, 1993 and 1994, have been above average. The result of these trends in year-class strength are that the biomass levels have been relatively stable for the past four years (Fig. 36). The history of recruitment since the stock started to rebuild in 1983 is that incoming 4 year-olds have ranged from 50 to 150 million individuals. Two very strong year-classes, 1988 and 1991, consisted of greater than 300 million individuals. It is only the influence of these year-classes which increased 4+ biomass levels to above 80,000 t (Fig. 36) and unless year-classes of this size appear again, no major increases in biomass or $F_{0.1}$ levels can be expected.

Prior to 1998, estimates of 4+ fall spawner biomass peaked in 1991, when the very large 1987 year-class appeared in the fishery. The population declined until 1996, when the large 1992 year-class appeared in the fishery. Since then, year-classes have been above average and the population is growing. A major uncertainty still remains in the assessment of fall spawners in the tendency to over-estimate four year-olds. The use of experimental nets to predict recruitment may help with this problem.

This assessment was the first one in which standardized strata from the acoustic survey were used to calculate an abundance index. The results from including this index in the population model supported the catch rate index results for spring spawners but not for fall spawners. The reason for this difference needs to be investigated.

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Table 1. Catch (t) of 4T herring caught in spring and fall, by gear (fixed and mobile) and spawning group (as calculated by the GSI method). Catch (t) in 4Vn from the purse seine fishery (Nov-Mar) is assigned to a spawning group according to otolith characteristics up to 1991 inclusive.

YEAR	SPAWNING GROUP a	4T SPRING		4T FALL		4T CATCH	4T TAC	4Vn CATCH	4Vn TAC	BIOMASS	
		Fixed	Mobile	Fixed	Mobile					Fall 4+	Spring 4+
1978	P	8,098	6,277	109	8,047	22,531		1,168			
	A	449	1,770	5,032	23,708	30,959		1,681			
	Total	8,547	8,047	5,141	31,756	53,490	55,000	2,849	8,000	71,611	44,364
1979	P	7,089	6,951	282	5,821	20,143		1,426			
	A	535	6,951	5,793	14,798	28,077		1,484			
	Total	7,624	13,902	6,075	20,619	48,220	55,000	2,910	3,000	55,460	30,158
1980	P	7,218	6,123	306	4,519	18,164		1,348			
	A	58	7,794	6,239	10,293	24,382		2,503			
	Total	7,272	13,917	6,545	14,812	42,546	55,000	3,851	4,500	39,308	19,400
1981	P	7,028	10	665	938	8,641		1,374			
	A	473	11	10,560	2,250	13,294		2,060			
	Total	7,501	21	11,225	3,188	21,935	16,000	3,434	3,000	58,970	10,011
1982	P	5,872	29	332	335	6,568		1,549			
	A	51	33	12,650	2,243	14,977		1,971			
	Total	5,923	62	12,982	2,578	21,545	16,000	3,520	3,000	95,804	8,036
1983	P	8,211	9	425	1,047	9,692		1,154			
	A	312	10	13,415	2,442	16,179		2,826			
	Total	8,523	19	13,840	3,489	25,871	20,000	3,980	5,000	145,398	22,401
1984	P	5,001	2	481	387	5,871		1,138			
	A	281	2	15,493	1,891	17,667		2,787			
	Total	5,282	4	15,974	2,278	23,538	19,000	3,925	3,500	224,301	39,027
1985	P	6,535	0	4,018	2,036	12,589	6,000	1,006			
	A	682	0	19,689	4,986	25,357	26,500	2,464			
	Total	7,217	0	23,707	7,022	37,946	32,500	3,470	3,500	265,486	62,199
1986	P	8,015	0	3,249	4,026	15,290	7,200	1,262			
	A	535	0	36,642	6,889	44,066	36,200	3,090			
	Total	8,550	0	39,891	10,915	59,356	43,400	4,352	4,200	290,984	64,234
1987	P	10,789	0	2,417	4,363	17,569	8,200	332			
	A	970	0	49,711	9,341	60,022	64,600	2,040			
	Total	11,759	0	52,128	13,734	77,621	72,800	2,372	4,200	311,790	78,712

a P: Spring/Printemps; A: Fall/Automne

Table 1 (cont'd). Catch (t) of 4T herring caught in spring and fall, by gear and spawning group.

Year	Spawning Group	4T Spring Fixed	Mobile	4T Fall Fixed	Mobile	4T Catch	4T TAC	4Vn Catch	4Vn TAC	Fall 4+ Biomass	Spring 4+ Biomass
1988	P	11,541	0	3,278	6,644	21,463	12,800	257			
	A	1,346	1	37,933	10,887	50,167	66,100	2,315			
	Total	12,887	1	41,211	17,531	71,630	78,900	2,572	4,200	313,437	70,009
1989	P	10,441	0	1,564	4,138	16,143	18,800	212			
	A	652	0	32,285	10,131	43,068	70,100	1,905			
	Total	11,093	0	33,849	14,269	59,211	88,900	2,117	4,200	280,479	62,727
1990	P	8,520	1	1,331	3,815	13,667	21,000	706			
	A	540	0	55,790	6,494	62,824	65,900	4,005			
	Total	9,060	1	57,121	10,309	76,491	86,900	4,711	4,200	268,118	62,278
1991	P	12,586	17	178	2,095	14,876	21,000	957			
	A	306	1	26,966	5,964	33,237	65,900	3,832			
	Total	12,892	18	27,144	8,059	48,113	86,900	4,789	4,200	327,476	88,553
1992	P	12,438	952	239	1,850	15,479	21,000	296			
	A	37	168	32,840	5,265	38,310	65,900	3,932			
	Total	12,475	1,121	33,079	7,115	53,790	86,900	4,228	4,200	344,364	102,137
1993	P	14,584	2,175	917	1,388	19,064	21,000	219			
	A	598	541	22,181	4,840	28,160	80,800	3,736			
	Total	15,182	2,716	23,098	6,228	47,224	101,800	3,955	4,200	291,024	103,381
1994	P	18,754	2,910	1,422	1,879	24,965	21,000	324			
	A	260	1,023	52,390	5,081	58,754	80,800	2,920			
	Total	19,014	3,933	53,812	6,960	83,719	101,800	3,244	4,200	300,433	89,251
1995	P	13,970	1,408	1,798	5,775	22,950	21 000	153			
	A	31	436	52,937	9,567	62,962	80,800	3,990			
	Total	14,001	1,842	54,735	15,342	85,932	101,800	4,143	4,200	244,835	118,897
1996	P	15,536	1,280	1,061	3,500	21,378	17,000	734			
	A	548	627	44,733	4,406	50,313	51,140	3,551			
	Total	16,084	1,907	45,794	7,906	71,690	68,140	4,285	5,423	268,918	90,144
1997	P	13,164	1,252	147	1,651	16,213	18,500	150			
	A	16	226	34,937	4,156	39,336	50,000	3,381			
	Total	13,180	1,478	35,085	5,806	55,549	68,500	3,531	4,200	310,392	84,144
1998	P	13,785	781	131	973	15,850	18,500	3			
	A	126	243	39,002	3,604	42,974	54,248	49			
	Total	13,918	1,024	39,133	4,577	58,824	70,748	52	4,200	401,903	85,577

a P: Spring/Printemps; A: Fall/Automne

Table 2. Catch (tonnes) by season in fixed gear for 4T Southern Gulf of St. Lawrence herring. Catches compiled using ZIFF raw data files for 1986, and 1988-1998 spring. For 1987 and 1998 fall, purchase slip files were used.

SPRING SEASON - FIXED GEAR

	Area							
Year	16A	16B	16C	16D	16E	16F	16G	Total
86	234	1439	2282	328	3731	66	266	8347
87	206	4089	3082	106	3841	134	38	11496
88	78	6616	3560	108	2041	158	122	12682
89	88	3827	1556	74	5080	134	62	10822
90	62	1715	2232	167	4285	141	17	8618
91	26	2139	5159	193	5018	127	16	12678
92	26	2856	4348	243	4699	146	54	12372
93	34	2377	4533	885	6893	200	124	15047
94	129	1550	6187	218	10499	154	71	18809
95	13	1029	4799	1039	6993	95	27	13995
96	123	460	5380	1628	8428	37	40	16096
97	23	274	3072	619	9221	18	2	13229
98	60	219	3023	1907	7541	176	607	13533
Mean 93-97	64	1138	4794	878	8407	101	53	15435

FALL SEASON - FIXED GEAR

	Area							
Year	16A	16B	16C	16D	16E	16F	16G	Total
86	124	25959	93	0	1570	5816	6638	40199
87	208	31653	902	1	1090	9495	8660	52009
88	68	22111	1254	9	2591	9141	6102	41276
89	95	26431	1015	0	517	3160	2905	34123
90	110	31926	753	2	2405	10343	10957	56496
91	34	17181	1559	1	3242	1906	3122	27044
92	35	23559	1789	18	2540	1919	3160	33019
93	87	14597	3062	618	1977	935	1786	23062
94	74	34473	4086	1460	2118	8095	3483	53789
95	77	29448	5164	1901	4216	10113	3816	54735
96	86	21381	2817	1448	4688	7754	7608	45782
97	17	16540	2008	163	3969	6218	6132	35047
98	10	17845	1844	1213	5215	5466	7204	38797
Mean 93-97	67	23210	3468	1118	3347	6664	4514	42388

Table 3. Catch (tonnes) by season in 1998 fixed gear for 4T Southern Gulf of St. Lawrence herring. Catches are from purchase slip files except for fall bait, small seiner catches, and seiner (>65') catches outside Chaleur Bay which are from quota monitoring. Fall 4T includes allocation for 4Vn inshore.

1998 SOUTHERN GULF OF ST. LAWRENCE TACs and QUOTA ALLOCATIONS

Fishing Area	TAC (t)	Sharing TAC		Inshore		Seiners (>65')	
		Inshore	Seiners	Allocation	Catch	Allocation	Catch
Spring 4T	16,500	77%	23%	12,708	13,907	3,792	1,004
Fall 4T	54,248	79%	21%	43,045	39,129	11,203	4,575
Winter 4Vn	4,200		100%			4,200	52
Total Fall	58,448	74%	26%	43,045	39,129	15,403	4,627
Total (Spring + Fall)	74,948	74%	26%	55,753	53,036	19,195	5,631

1998 SPRING FISHERY

Area	Season	TAC (t)	Catch (t)
INSHORE			
Isle Verte 16A	Jan – June 15	130	52
Chaleur Bay 16B	Jan – June 15	800	152
Escuminac 16C	Jan 1-May 31	4,100	2,982
Magdalen Islands 16D	Jan – June 15	1,200	1,887
Southeast NB – West PEI 16E	Jan – May 31	5,100	7,498
Guilf Nova Scotia 16F	Jan – June 15	300	148
East PEI 16G	Jan – June 15	200	456
Bait and Roe Fisheries all 4T	Jan – June 15	745	732
4Vn		133	66
Total Inshore		12,708	13,973
SEINERS (>65')			
All 4T	Ap 1 - June 30	3,792	1,004
Grand Total		16,500	14,977

1998 FALL FISHERY

Area	Season	Consistent Weekend Closure	Vessel Limit (lb)	TAC (t)	Catch (t)
INSHORE					
Isle Verte 16A	July 1-Dec 31	none	20,000	330	10
Chaleur Bay 16B	Aug 1-Dec 31	2 days	20,000	18,399	17,805
Chaleur Bay 16B Bait	Jul 1-Dec 31			880	40
Escuminac 16C - Wst PEI 16E	Aug 1-Dec 31	none	20,000	7,260	7,059
Magdalen 16D	Aug 1-Dec 31	1 day	20,000	1,375	1,213
Pictou 16F	Jul 1-Dec 31	2 days	15,000	6,820	5,466
Fisherman's Bank 16G	Aug 1-Dec 31	2 days	15,000	6,820	7,204
Quebec Small Seiners	Aug 1-Dec 31			605	332
4Vn				556	154
Total Inshore				42,165	39,283
SEINERS (>65')					
Within Chaleur Bay	Sept - Dec			9,464	3,597
Outside Chaleur Bay	Sept - Dec			1,739	978
All 4T				11,203	4,575
4Vn	Nov - Mar			4,200	52
Total Seiners				15,403	4,627
Grand Total				57,568	43,910

Table 4. Average price paid per pound to purse seiners and gillnetters in the Gulf Region, spring and fall fisheries. Na = not available.

Year	Spring and Fall Purse Seine (cents/lb)	Spring and Fall Gillnets (cents/lb)	Fall Gillnets (cents/lb)	Spring Gillnets (cents/lb)
83	9.44	Na		
84	8.08	Na		
85	9.10	Na		
86	8.07	Na		
87	9.04	12.00		
88	7.15	8.00		
89	5.00	3.00-4.00		
90	6.21	5.00-6.00		
91	5.65	3.00-4.00		
92	5.60	3.00-4.00		
93	5.00	3.00-4.00		
94	5.50	6.00-8.00		
95	6.50	10.00-12.00		
96	7.60	14-20		
97	7.90		7.60	6.90
98	7.30		7.00	8.20

Table 5. Number of respondents by area, homeport, and area of fishing activity for spring gillnetters called during the phone survey. See Fig. 6 for area locations. Total number surveyed for spring was 128.

	Fishing Location						
Home Area	Mag Is	Quebec	Acad Pen	Esc	SE N.B.	N. S.	West PEI
Magdalen Is	19						
Quebec		12					
Acadian Pen		1	5	2			
Escuminac				17	12		
SE N.B.					24		
Nova Scotia					1	3	
West PEI							32

Table 6. Number of respondents by area, homeport, and area of fishing activity for fall gillnetters called during the phone survey. See Fig. 6 for area locations. Total number surveyed for fall was 167.

Home Area	Fishing Location Mag Is	Quebec	Ac. Pen	Esc	SE N.B.	N. S.	West PEI	East PEI
Magdalen Is	6							
Quebec		9						
Acadian Pen		20	55	4				
Escuminac				4				
SE N.B.					1			
Nova Scotia						31		
West PEI							20	
East PEI								17

Table 7. Average length of gillnets (fathoms) used in the 1998 herring fishery. See Fig. 6 for area locations.

Area	Spring	Fall
Mag Is.	17.3	17.8
Quebec	19.1	16.3
Ac Pen.	16.2	15.7
Escuminac	14.1	15.0
SE NB	14.0	17.0
NS\NE	21.7	13.1
EPEI	-	18.0
WPEI	13.4	14.4

Table 8. Percent distribution of gillnet types used in the 1998 herring fishery. See Fig. 6 for area locations.

	Spring %		Fall %	
Area	Set	Modified	Set	Modified
Mag Is	98	2	0	100
Quebec	100	0	8	92
Ac Pen.	43	57	3	97
Escuminac	100	0	16	84
SE NB	100	0	100	0
NS\NE	100	0	100	0
EPEI	-	-	100	0
WPEI	100	0	100	0

Table 9. Number of nets used in 4T during fall and spring herring gillnet fisheries.

Year	Fall	Spring
78	11.4	29.4
79	11.9	34.4
80	10.4	20.2
81	9.6	18.6
82	6.0	20.4
83	7.3	22.5
84	5.3	26.5
85	5.2	37.2
86	5.2	26.6
87	4.7	23.9
88	5.0	19.9
89	5.3	26.6
90	5.2	29.4
91	5.0	27.6
92	5.0	22.7
93	5.4	24.0
94	5.4	22.9
95	5.5	21.7
96	4.8	20.7
97	5.2	20.2
98	5.5	24.5

Table 10. Average number of nets used during the fall inshore fishery in statistical districts accounting for most of the fall inshore catch.

	Statistical District						
	Gulf Nova Scotia		Acadian Peninsula			PEI	
Year	11	13	65	66	67	87	92
86	10	12	9	5	8	10	10
87	10	9	5	5	6	8	8
88	9	8	9	6	7	10	10
89	6	7	6	6	7	8	11
90	7	8	6	6	6	10	7
91	10	5	5	5	6	12	7
92	9	4	7	5	7	7	9
93	5	8	7	6	6	7	9
94	6	6	10	5	5	7	12
95	7	6	7	5	5	8	8
96	6	6	5	5	5	8	8
97	5	5	6	5	5	7	7
98	6	6	6	6	5	8	7

Table 11. Average number of nets used during the spring fishery in Escuminac, NB (16C) and Southeast New Brunswick (16E).

Year / Année	Escuminac	Southeast New Brunswick
86	25	28
87	21	40
88	19	33
89	20	31
90	20	35
91	16	37
92	15	30
93	18	31
94	15	31
95	22	34
96	18	29
97	19	27
98	26	26

Table 12. Age-length keys and length-weight relationships used to derive 1998 catch and weight-at-age matrices for 4T herring. Individual keys are compiled by North, Middle, Southern, and 4Vn regions. A * indicates that all the spring spawners caught during the fall season, and a ** indicates that all the fall spawners caught during the spring season, were used to determine the length-weight relationship.

Season	Gear	Region	Fishery	Area	Sp Grp	Intercept a	Transformed a	Slope b	Number of fish Aut	Prin	No.samples	Landings(t)
Fall	Fixed	North	Gaspe (16A)	4Topq	Prin	insuf. data						10
		North	Chaleur (16B) - Bait	4Tmn	Aut	-5.24	0.00000570	3.118				
		North	Chaleur (16B) - Bait	4Tmn	Prin	-5.78	0.00000165	3.438	36	44	3	40
		North	Chaleur (16B) - Roe	4Tmn	Aut	-5.24	0.00000570	3.118				
		North	Chaleur (16B) - Roe	4Tmn	Prin	-5.78	0.00000165	3.438	576	5	19	17805
		Middle	Esc - WPEI (16CE)	4Tl	Aut	-4.82	0.00001509	2.843	289	0	8	7059
		South	Iles-de-la-Mad (16D)	4Tf	Aut	-4.55	0.00002828	2.642	188	0	5	1213
		South	Fish. Bank (16G)	4Tg	Aut	-4.72	0.00001906	2.765				
		South	Fish. Bank (16G)	4Tg	Prin	-5.80	0.00000158	3.464 *	395	2	11	7204
		South	Pictou (16F)	4Th	Aut	-4.83		2.839	424	0	11	5466
	Mobile	North	Purse Seine	4Tmno	Aut	-5.88	0.00000131	3.511				
		North	Purse Seine	4Tmno	Prin	-5.97	0.00000108	3.584	296	5	11	3598
		Middle	Purse Seine	4Tl	one a and b for all fall mobile samples				31	1	1	978
		4Vn	Purse Seine	4Vn	*				29	6	1	52
Spring	Fixed	North	Gaspe (16A)	4Topq	Aut	-5.20	0.00000626	3.087 **				
		North	Gaspe (16A)	4Topq	Prin	-4.73	0.00001875	2.725	2	102	3	56
		North	Chaleur (16B)	4Tmn	Aut	-5.20	0.00000626	3.087 **				
		North	Chaleur (16B)	4Tmn	Prin	-6.02	0.00000095	3.597	1	126	4	182
		Middle	Esc - WPEI-May	4Tl	Aut	-5.20	0.00000626	3.087 **				
		Middle	Esc - WPEI-May	4Tl	Prin	-5.80	0.00000159	3.449	3	287	11	7304
		Middle	Esc - WPEI-June	4Tl	Prin	-5.98	0.00000104	3.574	0	96	3	248
		South	Iles-de-la-Mad (16D)	4Tf	Aut	-5.20	0.00000626	3.087 **				
		South	Iles-de-la-Mad (16D)	4Tf	Prin	-5.48	0.00000334	3.225	4	168	6	1900
		South	16E,16F,16G-May	4Tghjk	Aut	-5.20	0.00000626	3.087 **				
		South	16E,16F,16G-May	4Tghjk	Prin	-5.77	0.00000168	3.424	1	350	13	3421
		South	16E,16F,16G-June	4Tghjk	Prin	-5.47	0.00000339	3.232	0	155	5	798
	Mobile	South	Purse Seine	4Tg	Aut	-5.20	0.00000626	3.087 **				
		South	Purse Seine	4Tg	Prin	-5.61	0.00000248	3.338	40	147	4	1004

Table 13. Cumulative catch(t) and effort (trips) for spring fisheries in 16A and 16D. Sp. Group is number of fish sampled in each spawning group. Data in this table comes from the raw ZIF files.

16D			Cumulative		Sp. Group			16A	4To	4Tpq	total	4To	4Tpq	total	Cumulative		Sp. Group		
Date	Catch	Effort	Catch	Effort	Fall	Spring	Samples		Catch	Catch	Catch	Effort	Effort	Effort	Catch	Effort	Fall	Spring	Samples
402	0	0	0	0				402	0	0	0	0	0	0	0	0			
404	0	0	0	0				404	0	0	0	0	0	0	0	0			
405	0	0	0	0				405	2	0	2	2	0	2	2	2			
406	3	1	3	1				406	0	0	0	2	0	2	2	4			
407	1	1	4	2				407	3	0	3	4	0	4	5	8			
408	8	4	12	6				408	0	0	0	5	0	5	5	13			
409	6	4	18	10				409	0	0	0	5	0	5	5	18			
410	3	1	21	11				410	0	0	0	5	0	5	5	23			
413	54	26	75	37				413	1	0	1	5	0	5	6	28			
414	45	14	120	51				414	0	0	0	6	0	6	6	34			
415	101	38	221	89				415	0	0	0	6	0	6	6	40			
416	85	35	306	124		23	1	416	0	0	0	6	0	6	6	46			
417	56	29	362	153				417	0	0	0	6	0	6	6	52			
418	12	7	374	160				418	0	0	0	7	0	7	6	59			
420	218	76	592	236				420	0	0	0	0	0	0	6	59			
421	165	44	757	280				421	0	0	0	7	0	7	6	66			
422	301	85	1058	365		30	1	422	0	0	0	0	0	0	6	66			
423	189	76	1247	441				423	0	0	0	7	0	7	6	73			
424	78	40	1325	481				424	0	0	0	0	0	0	6	73			
425	27	3	1352	484				425	0	0	0	7	0	7	6	80			
427	387	73	1739	557				426	0	0	0	8	0	8	6	88			
428	102	17	1841	574	4	23	1	430	1	0	1	9	0	9	7	97			

Table 13. cont.

16D Date	Catch	Effort	Cumulative Catch	Cumulative Effort	Sp. Group Fall	Sp. Group Spring	Samples	16A	4To Catch	4Tpq Catch	total Catch	4To Effort	4Tpq Effort	Total Effort	Cumulative Catch	Cumulative Effort	Sp. Group Fall	Sp. Group Spring	Samples
501	0	0	1841	574				501	1	0	1	9	0	9	8	106			
503	0	0	1841	574				503	0	1	1	9	1	10	9	116			
504	0	0	1841	574				504	2	1	3	12	2	14	12	130		35	1
505	1	1	1842	575				505	0	1	1	0	2	2	13	132		33	1
506	0	0	1842	575				506	0	1	1	0	3	3	14	135			
507	0	0	1842	575		26	1	507	0	1	1	12	4	16	15	151			
508	0	0	1842	575				508	1	1	2	13	5	18	17	169			
509	0	0	1842	575				509	0	1	1	13	6	19	18	188			
510	0	0	1842	575				510	0	0	0	14	6	20	18	208			
512	0	0	1842	575				512	0	0	0	14	6	20	18	228			
513	0	0	1842	575				513	2	0	2	16	6	22	20	250			
514	0	0	1842	575				514	0	0	0	16	0	16	20	266			
515	2	1	1844	576				515	0	0	0	17	0	17	20	283			
516	14	2	1858	578				518	0	1	1	0	7	7	21	290			
517	5	3	1863	581				519	0	1	1	0	8	8	22	298			
520	6	2	1869	583				520	0	1	1	0	9	9	23	307			
521	0	1	1869	584				521	0	1	1	0	10	10	24	317			
522	6	1	1875	585		34	1	524	0	1	1	0	11	11	25	328			
523	12	2	1887	587				525	0	2	2	0	13	13	27	341			
526	0	0	1887	587				526	0	0	0	0	13	13	27	354			
527	0	0	1887	587		32	1	527	1	1	2	18	14	32	29	386			
528	0	0	1887	587				528	0	1	1	0	15	15	30	401			
529	0	0	1887	587				529	0	0	0	0	0	0	30	401			
530	0	0	1887	587				530	0	2	2	18	17	35	32	436			
531	0	0	1887	587				531	1	5	6	19	22	41	38	477			
601	0	0	1887	587				601	0	1	1	0	23	23	39	500			
602	0	0	1887	587				602	0	1	1	0	24	24	40	524			
603	0	0	1887	587				603	0	0	0	0	25	25	40	549			
604	0	0	1887	587				604	4	1	5	23	25	48	45	597	2	34	1
605	0	0	1887	587				605	3	3	6	25	28	53	51	650			
606	0	0	1887	587				606	0	0	0	25	28	53	51	703			
616	0	0	1887	587				616	1	0	1	27	0	27	52	730			
618	0	2	1887	589				618	2	0	2	28	0	28	54	758			
619	10	7	1897	596				619	0	0	0	0	0	0	54	758			
620	0	2	1897	598				620	2	0	2	31	0	31	56	789			
623	1	4	1898	602				623	0	0	0	0	0	0	56	789			
625	0	4	1898	606				625	0	0	0	0	0	0	56	789			
627	2	2	1900	608				627	0	0	0	0	0	0	56	789			
Total	1900	612			4	168	6		27	29	56	456	333	789			2	102	3

Table 14. Cumulative catch(t) and effort (trips) for spring 16B inshore fishery. Data is from purchase slip files. Date is MDD. PS-Day is a purchase slip record recorded by day.

16B	Catch					Effort							Samples		
Date	NB PS-Day	NB Week	NB Total	PQ PS-Day	Total NB+PQ	NB PS-Day	NB Week	NB Total	PQ PS-Day	Total NB+PQ	Cumulative Catch	Cumulative Effort	Sp. Group Fall	Sp. Group Spring	Samples
410	0		0	0	0	0		0	1	1	0	0			
422	0		0	1	1	0		0	1	1	1	1			
425	0		0	1	1	0		0	2	2	2	3			
426	0		0	1	1	0		0	1	1	3	4			
502	0		0	4	4	0		0	7	7	7	11			
503	0		0	3	3	0		0	3	3	10	14			
504	0		0	0	0	0		0	1	1	10	15			
505	0		0	1	1	0		0	4	4	11	19			
506	0		0	13	13	0		0	10	10	24	29			
507	0		0	4	4	0		0	8	8	28	37			
509	0		0	18	18	0		0	10	10	46	47			
510	0		0	26	26	0		0	9	9	72	56			
511	0		0	26	26	0		0	8	8	98	64		32	1
512	0		0	1	1	0		0	2	2	99	66			
516	0	2	2	0	2	0	2	2	0	2	101	68			
518	0		0	0	0	0		0	2	2	101	70			
522	0		0	0	0	0		0	1	1	101	71			
523	0		0	10	10	0		0	1	1	111	72			
525	0		0	0	0	0		0	1	1	111	73			
527	0		0	0	0	0		0	1	1	111	74			
529	0		0	3	3	0		0	1	1	114	75			
530	0		0	11	11	0		0	3	3	125	78			
531	0		0	0	0	0		0	1	1	125	79			
601	0		0	2	2	0		0	1	1	127	80			
602	0		0	1	1	0		0	1	1	128	81	1	31	1
606	0		0	0	0	0		0	2	2	128	83			
607	0		0	0	0	0		0	3	3	128	86			
608	0		0	5	5	0		0	6	6	133	92			
609	0		0	0	0	0		0	2	2	133	94		33	1

Table 14 (cont).

16B Date	Catch NB PS-Day	NB Week	NB Total	PQ PS-Day	Total NB+PQ	Effort NB PS-Day	NB Week	NB Total	PQ PS-Day	Total NB+PQ	Cumulative Catch	Cumulative Effort	Samples Sp. Group Fall	Spring	Samples
610	0		0	4	4	0		0	3	3	137	97			
611	0		0	4	4	0		0	2	2	141	99			
612	0		0	4	4	0		0	2	2	145	101			
613	0		0	7	7	1		1	7	8	152	109			
614	0		0	0	0	1		1	1	2	152	111			
615	0		0	0	0	0		0	1	1	152	112			
616	9		9	5	14	2		2	2	4	166	116			
617	0		0	0	0	1		1	1	2	166	118			
618	0		0	0	0	0		0	2	2	166	120			
619	0		0	0	0	1		1	2	3	166	123			
620	0		0	0	0	2		2	1	3	166	126			
621	0		0	16	16	0		0	1	1	182	127			
622	0		0	0	0	1		1	0	1	182	128		30	1
623	0		0	0	0	0		0	1	1	182	129			
627	0		0	0	0	0		0	2	2	182	131			
628	0		0	0	0	0		0	1	1	182	132			
629	0		0	0	0	1		1	3	4	182	136			
630	0		0	0	0	1		1	3	4	182	140			
Total	**9**	**2**	**11**	**171**	**182**	**11**	**2**	**13**	**128**	**141**			**1**	**126**	**4**

Table 15. Cumulative catch(t) and effort(trips) in 16C spring inshore fishery. Date is month day. PS-Day are daily purchase slip records, PS-Week are purchase slip records reported by week. Supp-B are fishery officer reports.

Date	Catch				Effort				Cumulative		Sp. Group		
	PS-Day	PS-Week	Supp-B	Total	PS-Day	PS-Week	Supp-B	Total	Catch	Effort	Fall	Spring	Samples
425	1			1	1			1	1	1			
426	1			1	4			4	3	5			
427	15			15	10			10	18	15			
428	67			67	35			35	85	50		25	1
429	153			153	42			42	238	92			
430	399		9	408	65		2	67	646	159		22	1
501	457			457	61			61	1103	220			
502	19			19	5			5	1122	225			
503	107			107	26			26	1229	251			
504	589			589	82			82	1818	333	1	44	2
505	262			262	52			52	2080	385		22	1
506	357			357	60			60	2437	445	1	30	1
507	169			169	50			50	2606	495			
509	5			5	1			1	2611	496			
513	16			16	7			7	2627	503			
514	166			166	55			55	2793	558		33	1
515	110			110	47			47	2903	605		29	1
519	69			69	25			25	2972	630		31	1
527									2972	630		35	1 Bait
528									2972	630		30	1 Bait
530	0		1	1	0		1	1	2973	631			
531	0		9	9	0		4	4	2982	635			
601									2982	635		31	1 Bait
603	0			0	3			3	2982	638			
605	7			7	1			1	2989	639			
607	1			1	4			4	2990	643			
608	1			1	5			5	2991	648			
609	0			0	2			2	2991	650			
610	0			0	2			2	2991	652			
611	1			1	5			5	2992	657			
612	1			1	11			11	2993	668			
613	3			3	15			15	2996	683			
616	0			0	2			2	2996	685			
617	0			0	1			1	2996	686			
630	0		24	24	0		5	5	3020	691			
Total	**2976**	**0**	**43**	**3020**	**679**	**0**	**12**	**691**			**2**	**332**	**12**

Table 16. Cumulative catch(t) and effort(trips) for 16E spring inshore fishery. Date is month, day. Samp = samples. PS-Day and PS-Week are purchase slip daily and weekly reports.

SENB												WPEI											
Date	Catch			Effort			Cumulative		Sp. Group			Date	Catch			Effort			Cumulative		Sp. Group		
	PS-Day	PS-Week	Supp -B	Total	PS-Day	PS-Week	Supp -B	Total	Catch	Effort	Fall	Spring	Samp		PS-Day	PS-Week	Supp -B	Total	PS-Day	PS-Week	Supp -B	Total	Catch	Effort	Fall	Spring	Samp
425	0			0	0			0	0	0				425	6			6	5			5	6	5			
426	38			38	24			24	38	24				426	48			48	32			32	53	37			
427	69			69	57			57	107	81				427	53			53	40			40	106	77			
428	49			49	49			49	156	130				428	71			71	63			63	177	140	1	46	2
429	92			92	68			68	248	198	23		1	429	53			53	34			34	230	174			
430	507			507	130			130	754	328				430	183			183	45			45	413	219			
501	1021			1021	178			178	1775	506				501	498	11		509	73	1		74	923	294			
502	439			439	107			107	2214	613				502	235			235	57			57	1158	351			
503	357			357	92			92	2571	705				503	259			259	80			80	1417	431			
504	571			571	115			115	3141	820				504	356			356	113			113	1773	544			
505	291			291	100			100	3432	920	53		2	505	359			359	94			94	2132	638		27	1
506	85			85	39			39	3518	959				506	129			129	57			57	2261	695	1	26	1
507	154			154	58			58	3671	1017				507	296			296	85			85	2557	780		25	1
508	198			198	65			65	3869	1082	27		1	508	407	3		410	88	1		89	2967	869			
511	1			1	1			1	3870	1083				509	0			0	1			1	2967	870			
513	3			3	2			2	3873	1085				513	65			65	23			23	3032	893			
514	168			168	58			58	4041	1143	80		3	514	180			180	76			76	3212	969		29	1
515	73			73	48			48	4114	1191	31		1	515	86			86	65			65	3298	1034		34	1
518	2			2	1			1	4116	1192				519	64			64	24			24	3362	1058			
525	0			0	1			1	4116	1193				521	3			3	3			3	3365	1061			
526	0			0	0			0	4116	1193				526	17			17	3			3	3382	1064			
601	15			15	5			5	4131	1198				601	41			41	11			11	3423	1075			
602	20			20	8			8	4151	1206	29		1	602	79			79	49			49	3502	1124			
603	13			13	10			10	4164	1216				603	93			93	74			74	3595	1198		33	1
604	0			0	0			0	4164	1216				604	3			3	6			6	3598	1204			
605	0			0	0			0	4164	1216				605	0			0	1			1	3598	1205			
606	0			0	0			0	4164	1216				606	0			0	1			1	3598	1206			
607	4			4	3			3	4168	1219				607	1			1	13			13	3599	1219			

Table 16. (cont.)

Date	SENB Catch PS-Day	PS-Week	Supp-B	Total	Effort PS-Day	PS-Week	Supp-B	Total	Cumulative Catch	Cumulative Effort	Sp. Group Fall	Spring	Samp
608	0			0	4			4	4169	1223			
609	0			0	3			3	4169	1226			
610	2			2	5			5	4171	1231			
611	0			0	1			1	4171	1232		60	2
612	0			0	0			0	4171	1232			
613	0			0	0			0	4171	1232			
614	0			0	0			0	4171	1232			
615	0			0	0			0	4171	1232			
616	0			0	0			0	4171	1232			
617	0			0	0			0	4171	1232			
618	0			0	1			1	4171	1233			
619	0			0	0			0	4171	1233			
620	0			0	0			0	4171	1233			
621	0			0	0			0	4171	1233			
622	0			0	0			0	4171	1233			
623	0			0	0			0	4171	1233			
624	0			0	0			0	4171	1233			
625	0			0	0			0	4171	1233			
626	0			0	0			0	4171	1233			
630	0			0	0			0	4171	1233			
Total	4172	0	0	4172	1233	0	0	1233			0	303	11

Date	WPEI Catch PS-Day	PS-Week	Supp-B	Total	Effort PS-Day	PS-Week	Supp-B	Total	Cumulative Catch	Cumulative Effort	Sp. Group Fall	Spring	Samp
608	1			1	17			17	3600	1236			
609	3			3	19			19	3603	1255			
610	42			42	35			35	3645	1290		33	1
611	5			5	30			30	3650	1320			
612	8			8	25			25	3658	1345			
613	7			7	25			25	3665	1370			
614	1			1	4			4	3666	1374			
615	2			2	21			21	3668	1395			
616	19			19	5			5	3687	1400			
617	13			13	4			4	3700	1404			
618	20			20	9			9	3720	1413			
619	12			12	20			20	3732	1433			
620	9			9	7			7	3741	1440			
621	10			10	2			2	3751	1442			
622	21			21	12			12	3772	1454			
623	6			6	12			12	3778	1466			
624	2			2	2			2	3780	1468			
625	2			2	3			3	3782	1471			
626	0			0	1			1	3782	1472			
630	0			0	2			2	3782	1474			
Total	3768	14	0	3782	1471	2	0	1473			2	253	9

Table 17. Cumulative catch(t) and effort(trips) for 16F and 16G spring inshore fisheries. Date is month, day. PS-Day and PS-Week are purchase slip daily and weekly reports. No samples were collected from the spring fishery in these areas.

	16F Gulf Nova Scotia									16G East PEI									
	Catch				Effort			Cumulative		Catch				Effort				Cumulative	
Date	PS-Day	Supp-B	Week	Total	PS-Day	Supp-B	Total	Catch	Effort	PS-Day	Supp-B	Week	Total	PS-Day	Supp-B	Week	Total	Catch	Effort
415										1			1	1			1	1	1
418										1			1	1			1	2	2
420	3			3	4		4	3	4	5			5	1			1	7	3
421	7			7	7		7	10	11	2			2	1			1	9	4
422	8			8	8		8	18	19	6			6	1			1	15	5
423	9			9	9		9	27	28	4			4	2			2	19	7
424	8			8	7		7	35	35	9			9	1			1	28	8
425	9			9	11		11	44	46	3			3	1			1	31	9
426	3			3	6		6	47	52	6			6	1			1	37	10
427	8			8	9		9	55	61	16			16	5			5	53	15
428	5			5	10		10	60	71	4			4	2			2	57	17
429	6			6	10		10	66	81	0			0	0			0	57	17
430	5	18		23	10	23	33	89	114	0	119		119	0	22		22	176	39
501	3			3	7		7	92	121	0		1	1	1		1	2	177	41
502	1			1	2		2	93	123	0			0	0			0	177	41
503	0			0	2		2	93	125	0			0	0			0	177	41
504	3			3	9		9	96	134	0			0	0			0	177	41
505	0			0	1		1	96	135	0			0	0			0	177	41
506										0			0	1			1	177	42
508										0		1	1	0		1	1	178	43
516	0			0	1		1	96	136	0			0	0			0	178	43
520	0			0	2		2	96	138	0			0	0			0	178	43
522	1			1	1		1	97	139	0			0	0			0	178	43
525	1			1	1		1	98	140	0			0	0			0	178	43
527	0			0	1		1	98	141	0			0	0			0	178	43
528	1			1	2		2	99	143	0			0	0			0	178	43
529	1			1	2		2	100	145	0			0	0			0	178	43
530	0	13		13	2	5	7	113	152	0	43		43	0	3		3	221	46
531	0	28		28	1	21	22	141	174	0	177		177	0	20		20	398	66

Table 17. (cont.)

	16F Gulf Nova Scotia									16G East PEI									
	Catch				Effort			Cumulative		Catch				Effort				Cumulative	
Date	PS-Day	Supp-B	Week	Total	PS-Day	Supp-B	Total	Catch	Effort	PS-Day	Supp-B	Week	Total	PS-Day	Supp-B	Week	Total	Catch	Effort
601	0			0	1		1	141	175	1			1	2			2	399	68
602	1			1	2		2	142	177	3			3	5			5	402	73
603										16			16	9			9	418	82
604	1			1	1		1	143	178	1			1	1			1	419	83
605	0			0	1		1	143	179	0			0	0			0	419	83
606	0			0	1		1	143	180	5			5	5			5	424	88
607	0			0	1		1	143	181	0			0	0			0	424	88
608	1			1	2		2	144	183	1			1	6			6	425	94
609	0			0	1		1	144	184	2			2	6			6	427	100
610	1			1	1		1	145	185	5			5	8			8	432	108
611										9			9	8			8	441	116
612	0			0	1		1	145	186	12			12	7			7	453	123
613	1	2		3	3	2	5	148	191	2			2	3			3	455	126
615	0			0	1		1	148	192	1			1	4			4	456	130
616	0			0	1		1	148	193	0			0	0			0	456	130
617	3			3	5		5	151	198	0			0	0			0	456	130
618	1			1	4		4	152	202	7			7	3			3	463	133
619	0			0	1		1	152	203	8			8	8			8	471	141
620	1			1	1		1	153	204	4			4	5			5	475	146
621										0			0	1			1	475	147
622	2			2	6		6	155	210	0			0	3			3	475	150
623	2			2	5		5	157	215	5			5	7			7	480	157
624	1			1	3		3	158	218	8			8	3			3	488	160
626	0			0	1		1	158	219	2			2	2			2	490	162
630	0	13		13	0	15	15	171	234	0	135		135	0	28		28	625	190
Total	97	74		171	168	66	234			149	474	2	625	115	73	2	190		

Table 18. Cumulative catch and effort for spring purse seine fishery in 16D and 16G combined.

Date	Catch	Effort	Cumulative Catch	Cumulative Effort	Sp. Group Fall	Sp. Group Spring	Samples
529	33	2	33	2			
603	151	2	185	4	4	39	1
608	200	3	385	7			
609	99	2	484	9	14	31	1
610	17	1	501	10			
611	150	4	652	14	22	77	2
612	59	2	711	16			
Total	709	16			40	147	4

Table 19. Cumulative catch and effort and sampling dates for 16A fall inshore fishery. Date is month, day.

	4To	4Tpq	total Catch	4To	4Tpq	Total Effort	Cumulative Catch	Cumulative Effort	Samples
812	1		1	1		1	1	1	none
814		0	0		1	1	1	2	
819	3		3	2		2	4	4	
831		0	0		1	1	4	5	
912	0		0	1		1	4	6	
919	1		1	1		1	5	7	
928	0		0	1		1	5	8	
930	0		0	1		1	5	9	
1002	0		0	1		1	5	10	
1006	1		1	1		1	6	11	
1008	0		0	1		1	6	12	
1010	0		0	1		1	6	13	
1012	1		1	1		1	7	14	
1014	1		1	1		1	8	15	
1016	1		1	1		1	9	16	
1017	0		0	1		1	9	17	
1019	0		0	1		1	9	18	
1021	1		1	1		1	10	19	
1023	0		0	1		1	10	20	
Total	10	0	10	18	2	20			

Table 19. Cumulative catch(t) and effort(trips) and sampling dates for 16A fall inshore fishery. Date is month, day. Data is from ZIF files.

	4To	4Tpq	total Catch	4To	4Tpq	Total Effort	Cumulative Catch	Cumulative Effort	Samples
812	1		1	1		1	1	1	none
814		0	0		1	1	1	2	
819	3		3	2		2	4	4	
831		0	0		1	1	4	5	
912	0		0	1		1	4	6	
919	1		1	1		1	5	7	
928	0		0	1		1	5	8	
930	0		0	1		1	5	9	
1002	0		0	1		1	5	10	
1006	1		1	1		1	6	11	
1008	0		0	1		1	6	12	
1010	0		0	1		1	6	13	
1012	1		1	1		1	7	14	
1014	1		1	1		1	8	15	
1016	1		1	1		1	9	16	
1017	0		0	1		1	9	17	
1019	0		0	1		1	9	18	
1021	1		1	1		1	10	19	
1023	0		0	1		1	10	20	
Total	10	0	10	18	2	20			

Table 20. Cumulative catch(t) and effort(trips) with sampling dates for 16B fall inshore fishery. Date is month, day. PS-Day are daily purchase slip reports.

Date	Catch			Effort			Cumulative		Samples		
	NB	PQ	Total	NB	PQ	Total			Sp. Group		
	PS-Day	PS-Day	NB+PQ	PS-Day	PS-Day	NB+PQ	Catch	Effort	Fall	Spring	Number
701	0	0	0	1	2	3	0	3			
702		4	4		2	2	4	5			
703	0	0	0	2	2	4	4	9			
704	0	0	0	5	2	7	4	16			
705		0	0		1	1	4	17			
706	0	0	0	1	1	2	4	19			
707		0	0		3	3	4	22			
709		1	1		1	1	5	23			
711		2	2		2	2	7	25			
712	0		0	2		2	7	27			
714	0	0	0	1	1	2	7	29			
715	0		0	1		1	7	30			
716	0		0	2		2	7	32			
717	0		0	1		1	7	33			
720	0	0	0	2	1	3	7	36			
721	0		0	2		2	7	38	6	23	1
722	0	0	0	1	1	2	7	40	11	12	1
724	0	1	1	1	1	2	8	42			
725	4	3	7	1	2	3	15	45			
807	0		0	1		1	15	46	19	9	1
812	0		0	1		1	15	47			
820	4	0	4	1	1	2	19	49			
821	9	0	9	1	1	2	28	51			
823	5	7	12	1	1	2	40	53			
824	2020	80	2100	251	16	267	2140	320	70	1	2
825	1007	63	1070	227	17	244	3210	564	30	1	1
826	206	11	217	109	9	118	3427	682	30	1	1
827	62	1	63	30	2	32	3490	714	33	0	1
828	389	23	412	119	6	125	3902	839			
829	25	16	41	2	2	4	3943	843			
830	14		14	1		1	3957	844			
831	1515	129	1644	196	23	219	5601	1063	55	1	2
901	1931	134	2065	249	26	275	7666	1338	63	0	2
902	1185	71	1256	237	20	257	8922	1595	63	0	2
903	101	126	227	17	21	38	9149	1633	59	0	2
904	115	41	156	36	13	49	9305	1682			
905	20		20	2		2	9325	1684			
906	16		16	1		1	9341	1685			
907	334	122	456	64	25	89	9797	1774			
908	282	87	369	86	30	116	10166	1890	30	0	1
909	20	9	29	7	4	11	10195	1901			
910	284	92	376	66	30	96	10571	1997	29	1	1
911	35	39	74	20	14	34	10645	2031			
913	23		23	3		3	10668	2034			
914	2061	199	2260	235	27	262	12928	2296			
915	2091	159	2250	230	29	259	15178	2555	84	0	3
916	1564	61	1625	204	13	217	16803	2772			
917	614		614	75		75	17417	2847			
918	4		4	5		5	17421	2852	30	0	1

Table 20 (cont.)

Date	Catch NB PS-Day	Catch PQ PS-Day	Catch Total NB+PQ	Effort NB PS-Day	Effort PQ PS-Day	Effort Total NB+PQ	Cumulative Catch	Cumulative Effort	Samples Sp. Group Fall	Samples Sp. Group Spring	Samples Number
922		45	45		12	12	17466	2864			
923	57	33	90	15	12	27	17556	2891			
925	10		10	3		3	17566	2894			
926	10		10	6		6	17576	2900			
927	12		12	5		5	17588	2905			
928	1		1	1		1	17589	2906			
929	38	76	114	4	10	14	17703	2920			
930	3	10	13	4	2	6	17716	2926			
1001	14	0	14	4	1	5	17730	2931			
1007	5		5	1		1	17735	2932			
1008	72		72	11		11	17807	2943			
1009	17		17	5		5	17824	2948			
1010	5		5	1		1	17829	2949			
1013	10		10	1		1	17839	2950			
1014	6		6	4		4	17845	2954			
Total	16200	1645	17845	2565	389	2954			612	49	22

Table 21. Cumulative catch(t) and effort(trips) with sampling dates for 16CE fall inshore fishery. Dates are month, day. PS-Day are daily purchase slip reports. Supp-B are fishery officer reports.

16C

	Catch			Effort			Cumulative		Sp. Group		
Date	PS-Day	Supp-B	Total	PS-Day	Supp-B	Total	Cat	Eff	Fall	Spr	Sam
702			0			0	0	0			
703			0			0	0	0			
726	2		2	1		1	2	1			
731		1	1		2	2	3	3			
807			0			0	3	3			
814			0			0	3	3			
815			0			0	3	3			
818			0			0	3	3			
820			0			0	3	3			
821			0			0	3	3			
822			0			0	3	3			
823			0			0	3	3			
826	14		14	2		2	17	5			
827			0			0	17	5			
828	58		58	8		8	75	13			
829	15		15	2		2	90	15			
831	53	7	60	16	5	21	150	36	24		1
901			0			0	150	36			
902	13		13	2		2	163	38			
903			0			0	163	38			
904			0			0	163	38			
905			0			0	163	38			
906			0			0	163	38			
907	45		45	16		16	208	54			
908	72		72	16		16	280	70			
909			0			0	280	70			

16E

	Cat	Eff	Cumulative		Sp. Group		
Date	PS-Day	PS-Day	Cat	Eff	Fall	Spr	Sam
702	0	1	0	1			
703	0	1	0	2			
726	0	0	0	2			
731	0	0	0	2			
807	0	1	0	3			
814	1	1	1	4			
815	0	1	1	5			
818	0	1	1	6			
820	0	1	1	7			
821	0	3	1	10			
822	0	1	1	11			
823	0	3	1	14			
826	93	25	94	39			
827	14	6	108	45			
828	68	29	176	74	36		1
829	302	40	478	114			
831	168	26	646	140			
901	58	18	704	158	36		1
902	195	39	899	197			
903	17	4	916	201			
904	75	20	991	221			
905	176	25	1167	246			
906	68	12	1235	258			
907	162	32	1397	290			
908	164	35	1561	325			
909	145	25	1706	350			

16CE

	Catch	Effort			Sp. Group		
	PS-Day	PS-Day	Cat	Eff	Fall	Spr	Sam
702	0	1	0	1	0	0	0
703	0	1	0	2	0	0	0
726	2	1	2	3	0	0	0
731	1	2	3	5	0	0	0
807	0	1	3	6	0	0	0
814	1	1	4	7	0	0	0
815	0	1	4	8	0	0	0
818	0	1	4	9	0	0	0
820	0	1	4	10	0	0	0
821	0	3	4	13	0	0	0
822	0	1	4	14	0	0	0
823	0	3	4	17	0	0	0
826	107	27	111	44	0	0	0
827	14	6	125	50	0	0	0
828	126	37	251	87	36	0	1
829	317	42	568	129	0	0	0
831	228	47	796	176	24	0	1
901	58	18	854	194	36	0	1
902	208	41	1062	235	0	0	0
903	17	4	1079	239	0	0	0
904	75	20	1154	259	0	0	0
905	176	25	1330	284	0	0	0
906	68	12	1398	296	0	0	0
907	207	48	1605	344	0	0	0
908	236	51	1841	395	0	0	0
909	145	25	1986	420	0	0	0

Table 21 (cont.)

16C

Date	Catch PS-Day	Catch Supp-B	Catch Total	Effort PS-Day	Effort Supp-B	Effort Total	Cumulative Cat	Cumulative Eff	Sp. Group Fall	Sp. Group Spr	Sp. Group Sam
910			0			0	280	70			
911	29		29	4		4	309	74			
913	110		110	14		14	419	88			
914	244		244	27		27	663	115			
915	292		292	32		32	955	147			
916	181		181	22		22	1136	169			
919	7		7	1		1	1143	170			
920			0			0	1143	170			
921	173		173	25		25	1316	195			
922	39		39	6		6	1355	201			
924	54		54	8		8	1409	209			
925	145		145	20		20	1554	229	33		1
926	164		164	19		19	1718	248			
927	110		110	13		13	1828	261			
928	2		2	3		3	1830	264			
930		9	9		4	4	1839	268			
1031	0	5	5	0	4	4	1844	272			
Total	1822	22	1844	257	15	272			57	0	2

16E

Date	Cat PS-Day	Eff PS-Day	Cumulative Cat	Cumulative Eff	Sp. Group Fall	Sp. Group Spr	Sp. Group Sam
910	115	22	1821	372			
911	317	51	2138	423	43		1
913	372	45	2510	468			
914	473	56	2983	524			
915	575	66	3558	590			
916	326	47	3884	637	35		1
919	462	60	4346	697			
920	82	16	4428	713			
921	419	52	4847	765			
922	25	11	4872	776			
924	0	0	4872	776			
925	160	29	5032	805	82		2
926	175	26	5207	831			
927	3	2	5210	833			
928	0	0	5210	833			
930	5	1	5215	834			
1031	0	0	5215	834			
Total	5215	834			232	0	6

16CE

Catch PS-Day	Effort PS-Day	Cumulative Cat	Cumulative Eff	Sp. Group Fall	Sp. Group Spr	Sp. Group Sam
115	22	2101	442	0	0	0
346	55	2447	497	43	0	1
482	59	2929	556	0	0	0
717	83	3646	639	0	0	0
867	98	4513	737	0	0	0
507	69	5020	806	35	0	1
469	61	5489	867	0	0	0
82	16	5571	883	0	0	0
592	77	6163	960	0	0	0
64	17	6227	977	0	0	0
54	8	6281	985	0	0	0
305	49	6586	1034	115	0	3
339	45	6925	1079	0	0	0
113	15	7038	1094	0	0	0
2	3	7040	1097	0	0	0
14	5	7054	1102	0	0	0
5	4	7059	1106	0	0	0
7059	1106			289	0	8

Table 22. Cumulative catch(t) and effort(trips) with sampling dates for 16D fall inshore fishery. Date is month, day. PS-Day are purchase slip daily reports.

	PS-Day		Cumulative		Spawning Group		Sample Number
Date	Catch	Effort	Catch	Effort	Fall	Spring	
806	0	1	0	1			
810	0	1	0	2			
814	5	1	6	3			
815	2	3	8	6			
817	1	1	9	7			
820	0	1	9	8			
824	1	2	10	10			
826	0	1	11	11			
907	135	18	145	29			
908	292	40	438	69			
909	126	22	564	91			
910	209	25	773	116	39		1
911	129	37	902	153	31		1
914	234	43	1136	196	78		2
915	76	16	1212	212	40		1
1103	1	1	1213	213			
1109	0	1	1213	214			
Total	1211	214			188	0	5

Table 23. Cumulative catch(t) and effort(trips) with sampling dates for 16F fall inshore fishery. Dates are month, day. PS-Day are purchase slip daily reports, Supp-B are fishery officer reports.

	Catch			Effort			Cumulative		Sp. Group		
Date	PS-Day	Supp - B	Total	PS-Day	Supp - B	Total	Catch	Effort	Fall	Spring	Samp
703	0		0	2		2	0	2			
704	0		0	2		2	0	4			
706	0		0	3		3	0	7			
709	6		6	1		1	6	8			
710	7		7	1		1	13	9			
711	0		0	1		1	13	10			
731		10	10		5	5	23	15			
806			0			0	23	15			
807			0			0	23	15			
808			0			0	23	15			
809			0			0	23	15			
810			0			0	23	15			
811			0			0	23	15			
812			0			0	23	15			
815			0			0	23	15			
817			0			0	23	15			
818			0			0	23	15			
819			0			0	23	15			
821			0			0	23	15			
822	7		7	1		1	30	16			
824			0			0	30	16			
825			0			0	30	16			
826			0			0	30	16			
827			0			0	30	16			
828			0			0	30	16			
830			0			0	30	16			
831		10	10		5	5	40	21			
901			0			0	40	21			
902			0			0	40	21			
903			0			0	40	21			
904			0			0	40	21			
905			0			0	40	21			
907			0			0	40	21			
908	6		6	1		1	46	22			
909	179		179	29		29	225	51			
910	164		164	35		35	389	86	38		1
911	391		391	70		70	780	156	36		1
912	7		7	1		1	787	157			
914	130		130	39		39	917	196			
915	579		579	108		108	1496	304	38		1
916	448		448	86		86	1944	390	70		2
917			0			0	1944	390			
918	80		80	26		26	2024	416			
921	869		869	131		131	2893	547	82		2
922	524		524	106		106	3417	653	81		2
923	651		651	121		121	4068	774			
924			0			0	4068	774			
925	643		643	107		107	4711	881			
926			0			0	4711	881			

Table 23 (cont.)

	Catch			Effort			Cumulative		Sp. Group		
Date	PS-Day	Supp - B	Total	PS-Day	Supp - B	Total	Catch	Effort	Fall	Spring	Samp
927	7		7	1		1	4718	882			
928	228		228	49		49	4946	931	39		1
929	320		320	91		91	5266	1022			
930	45	39	84	23	6	29	5350	1051			
1008	87		87	19		19	5437	1070	40		1
1009	29		29	10		10	5466	1080			
Total	5407	59	5466	1064	16	1080			424	0	11

Table 24. Cumulative catch(t) and effort(trips) with sampling dates for 16G fall inshore fishery. Dates are month, day. PS-Day are purchase slip daily reports, Supp-B are fishery officer reports.

	Catch			Effort			Cumulative		Spawning Group		
Date	PS-Day	Supp - B	Total	PS-Day	Supp - B	Total	Catch	Effort	Fall	Spring	Samp
703			0			0	0	0			
704			0			0	0	0			
706	0		0	1		1	0	1			
709	0		0	1		1	0	2			
710			0			0	0	2			
711			0			0	0	2			
731		406	406		18	18	406	20			
806	16		16	6		6	422	26			
807	21		21	16		16	443	42			
808	28		28	9		9	471	51			
809	11		11	4		4	482	55			
810	19		19	17		17	501	72			
811	11		11	20		20	512	92			
812	0		0	1		1	512	93			
815	12		12	3		3	524	96			
817	92		92	18		18	616	114			
818	17		17	6		6	633	120	25	1	1
819	4		4	4		4	637	124			
821	32		32	13		13	669	137			
822	1		1	1		1	670	138			
824	85		85	27		27	755	165			
825	9		9	4		4	764	169			
826	175		175	36		36	939	205	37		1
827	167		167	36		36	1106	241	31		1
828	131		131	35		35	1237	276			
830	13		13	2		2	1250	278			
831	333	406	739	55	18	73	1989	351			
901	336		336	57		57	2325	408			
902	320		320	57		57	2645	465	37		1
903	29		29	6		6	2674	471	34		1
904	348		348	57		57	3022	528	35		1
905	7		7	2		2	3029	530			
907	40		40	22		22	3069	552			
908	213		213	42		42	3282	594			
909	407		407	63		63	3689	657	41	1	1
910	51		51	13		13	3740	670	34		1
911	400		400	73		73	4140	743			
912			0			0	4140	743			
914	536		536	84		84	4676	827			
915	505		505	85		85	5181	912			
916	183		183	57		57	5364	969			
917	27		27	5		5	5391	974			
918	68		68	20		20	5459	994			
921	483		483	74		74	5942	1068			
922	343		343	63		63	6285	1131	39		1
923	334		334	66		66	6619	1197	40		1
924	50		50	10		10	6669	1207			
925	47		47	25		25	6716	1232			
926	5		5	1		1	6721	1233			

Table 24 (cont.)

	Catch			Effort			Cumulative		Spawning Group		
Date	PS-Day	Supp - B	Total	PS-Day	Supp - B	Total	Catch	Effort	Fall	Spring	Samp
927	6		6	1		1	6727	1234			
928			0			0	6727	1234			
929	156		156	24		24	6883	1258			
930	26	295	321	15	17	32	7204	1290	42		1
1008			0			0	7204	1290			
1009	0		0			0	7204	1290			
Total	6097	1107	7204	1237	53	1290			395	2	11

Table 25. Cumulative catch(t) and effort (trips) and sampling dates for fall 4T purse seine fishery.

Date	Catch	Effort	Cumulative Catch	Cumulative Effort	Spawning Group Fall	Spawning Group Spring	Samples	NAFO Area
901	83	4	83	4	24	7	1	4TMN
902	288	5	371	9				
903	198	5	569	14	27	6	1	4TMN
904	227	4	796	18	25	15	1	4TMN
905	162	4	958	22				
906	66	1	1025	23				
907	163	5	1188	28				
910	188	4	1376	32	25	11	1	4TMN
911	148	4	1524	36				
913	202	4	1726	40				
914	513	5	2239	45				
915	204	3	2443	48	31	1	1	4TL
916	108	2	2551	50				
918	50	2	2601	52				
919	4	1	2605	53				
920	4	1	2608	54				
921	94	4	2703	58				
924	23	1	2726	59				
926	138	5	2864	64	19	13	1	4TO
927	18	2	2883	66				
929	50	4	2932	70	23	16	1	4TMN
1001	24	2	2957	72				
1005	84	3	3041	75				
1007	194	4	3235	79	63	19	2	4TMN
1008	13	1	3248	80				
1009	3	1	3251	81	39	9	1	4TMN
1011	35	1	3286	82				
1013	164	5	3449	87				
1014	462	4	3911	91	27	11	1	4TMN
1015	98	4	4009	95	24	10	1	4TMN
Total 4T	4008	95			327	118	12	
1118	52	2	52	2	29	6	1	4Vn

Table 26. Catch-at-age for 4T fall spawning herring, including those caught in 4Vn. Numbers are in thousands of fish.

Fixed Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0	904	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	82	8	64	322	0	0	0	0	253	15	0	0	19	0	52	0	0	0	0	0	0
3	3592	474	7965	5753	2154	720	963	1117	1627	8010	1165	294	3706	158	325	78	0	53	9	947	72
4	5548	9986	5224	24124	14985	20231	24882	8816	32871	38205	20432	14113	22572	39459	12879	2440	9158	3483	19846	17675	23133
5	3484	5132	6097	6313	16883	9570	13445	24441	16497	30249	41943	22056	19815	10235	54288	29704	12264	38155	19745	64160	32658
6	816	2924	994	2477	4922	13180	8306	14860	34428	20712	20253	29673	28214	7309	12201	36482	48412	14500	45273	13050	46943
7	745	885	1733	1027	2523	2168	5978	9498	19251	36337	13240	14057	54225	10784	7345	6034	69790	47315	10111	20135	11486
8	3911	1065	373	597	1050	1632	1335	4495	8212	15518	14266	7133	17002	13296	8943	3168	12224	42105	23761	3792	16607
9	117	879	232	258	371	486	456	1212	4666	9382	6953	9021	9163	4840	9347	3661	9658	7986	24446	6895	3092
10	157	278	304	239	117	124	200	727	341	4563	2738	3324	9958	2409	4554	1949	9640	5643	5291	6374	5927
11+	1903	545	96	102	62	160	91	159	692	1878	1623	2593	5404	4538	6705	2785	14115	14055	11126	3725	8681
	20355	23060	23082	41212	43067	48271	55656	65325	118838	164869	122613	102264	170079	93028	116639	86301	165262	173295	159607	136753	148599

Purse Seine

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0	240	140	0	0	0	0	0	5	20	77	0	0	0	0	0	0	0	0	0	0
2	1464	8555	2970	455	2088	1479	1031	1080	761	863	4283	752	43	0	61	47	15	14	311	222	44
3	22001	15905	39638	5059	8169	7995	3863	4024	3507	2526	3483	1399	4123	6448	565	2066	310	2977	2670	4893	1488
4	29044	21322	17650	11260	5597	8339	6727	8223	7400	5754	4028	4592	5475	22717	5682	2810	9164	4524	13685	6617	2784
5	24187	16923	12979	1315	3891	4192	5704	8085	8729	4032	6081	6959	7433	6142	15818	6033	3398	26780	5129	10307	4603
6	4902	16756	7906	699	661	1629	2367	5824	8079	9035	5667	7497	3402	1939	4258	10570	7957	8576	11130	2691	4398
7	4947	4734	8118	317	268	400	941	2540	8102	8593	9403	4483	5003	1947	2009	3667	11043	9677	4413	6893	750
8	10893	3702	6168	297	135	95	163	1826	3828	6883	8227	7390	2404	1964	1753	2738	2485	10657	3108	1202	2415
9	1898	5277	4233	503	149	108	91	731	1352	2326	4500	4737	4434	1788	1724	2002	1433	1924	2091	1917	274
10	1017	1249	2259	116	38	30	14	449	510	364	1417	2407	3534	995	1708	3571	1389	1415	1083	1185	937
11+	11937	10464	1389	64	178	57	20	420	217	82	2441	1658	3330	2235	5417	5739	2951	2336	843	1012	903
	112290	105157	103450	20085	21194	24324	20961	33202	42490	40478	49607	41874	39181	46175	39896	39243	40145	69077	44684	36741	18597

All Gears

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0	1144	143	0	0	0	0	0	5	20	77	0	0	0	0	0	0	0	0	0	0
2	1546	8563	3085	777	2088	1478	1031	1080	1014	879	4283	752	63	0	113	48	15	14	311	222	44
3	25594	16379	48009	10813	10324	8715	4847	5141	5134	10536	4649	1693	7830	6605	890	2145	309	3030	2679	5867	1560
4	34592	31309	23000	35384	20682	28586	31610	17039	40271	43959	24460	18705	28047	62176	18561	5251	18322	8007	33730	24610	25918
5	27672	22055	19127	7629	20775	13764	19149	32527	25225	34280	48025	29015	27248	16378	70106	35736	15662	64935	24874	75358	37260
6	5718	19709	8926	3175	5603	14811	10693	20685	42507	29747	25921	37170	31616	9248	16459	47052	56369	23076	56404	15781	51341
7	5692	5598	9984	1344	2792	2568	6919	12037	27353	44930	22644	18540	59229	12730	10254	9698	80833	57192	14524	27143	12236
8	14803	4766	6656	894	1186	1727	1498	6321	12040	22400	22494	14523	19406	15260	10696	5906	14710	52762	26869	5004	19023
9	2015	6156	4524	762	520	594	547	1943	6017	11708	11454	13758	13597	6627	11071	5663	11091	9910	26538	8874	3366
10	1174	1527	2595	355	155	154	214	1175	852	4926	4155	5731	13492	3404	6262	5519	11029	7058	6374	7597	6865
11+	13840	10409	1499	167	241	217	111	579	909	1960	4063	4251	8734	6773	12122	8524	17067	16390	11969	4769	9584
	132646	127615	127548	61300	64266	72613	76619	98527	161327	205345	172225	144138	209261	139202	156534	125542	225408	242374	204272	175225	167196

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Table 27. Weight-at-age (kg) for 4T fall spawners including those caught in 4Vn.

Fixed Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.0000	0.0231	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0787	0.1066	0.2115	0.1288	0.0000	0.0000	0.0000	0.0000	0.1793	0.1328	0.0000	0.0000	0.2675	0.0000	0.0658	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.1344	0.2015	0.2068	0.2048	0.2220	0.1908	0.2362	0.2573	0.1958	0.2347	0.2309	0.2260	0.2102	0.1959	0.1421	0.1596	0.0000	0.1247	0.0000	0.1711	0.1594
4	0.2371	0.2554	0.2577	0.2468	0.2660	0.2519	0.2484	0.2541	0.2485	0.2470	0.2645	0.2602	0.2499	0.2339	0.2202	0.2127	0.2085	0.2023	0.2208	0.2060	0.2121
5	0.2822	0.2934	0.3118	0.3101	0.3008	0.2853	0.2863	0.2917	0.2896	0.2789	0.2902	0.2955	0.2855	0.2675	0.2551	0.2349	0.2339	0.2296	0.2455	0.2347	0.2326
6	0.3074	0.3201	0.3587	0.3679	0.3370	0.3169	0.3219	0.3352	0.3248	0.3164	0.3252	0.3255	0.3248	0.3025	0.2818	0.2599	0.2583	0.2500	0.2574	0.2619	0.2587
7	0.3191	0.3553	0.3490	0.3950	0.3739	0.3493	0.3480	0.3611	0.3672	0.3434	0.3538	0.3532	0.3478	0.3360	0.3054	0.2822	0.2867	0.2799	0.2828	0.2766	0.2840
8	0.3667	0.3982	0.3672	0.4200	0.3825	0.3652	0.3974	0.3742	0.3848	0.3673	0.3794	0.3731	0.3684	0.3545	0.3423	0.3300	0.3150	0.2988	0.3055	0.3114	0.2951
9	0.3711	0.4171	0.4020	0.4585	0.3927	0.3724	0.4128	0.4102	0.4013	0.3818	0.4073	0.3847	0.3878	0.3732	0.3491	0.3520	0.3426	0.3335	0.3255	0.3289	0.3261
10	0.3479	0.4274	0.4354	0.4717	0.3700	0.4495	0.3794	0.4055	0.4315	0.3855	0.4095	0.4062	0.4038	0.3917	0.3640	0.3497	0.3589	0.3634	0.3628	0.3442	0.3443
11+	0.4324	0.4366	0.4310	0.5211	0.4674	0.4295	0.4896	0.4969	0.4337	0.4257	0.4381	0.4065	0.4319	0.4114	0.3987	0.3626	0.3837	0.3798	0.3954	0.3962	0.3660
	0.2770	0.2847	0.2718	0.2665	0.2963	0.2859	0.2848	0.3157	0.3117	0.3071	0.3196	0.3268	0.3309	0.2920	0.2835	0.2639	0.2878	0.2626	0.2837	0.2557	0.2628

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.0000	0.0692	0.0308	0.0000	0.0000	0.0000	0.0000	0.0000	0.0378	0.0389	0.0690	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.1023	0.1107	0.1089	0.0861	0.1154	0.1381	0.1253	0.1116	0.0925	0.0787	0.0959	0.1054	0.1081	0.0000	0.0661	0.0522	0.0912	0.0854	0.0965	0.0818	0.0729
3	0.1501	0.1554	0.1426	0.1801	0.1802	0.1831	0.1960	0.1948	0.1509	0.1658	0.1636	0.1606	0.1785	0.1509	0.1279	0.1413	0.1372	0.1202	0.1514	0.1439	0.1248
4	0.2202	0.1865	0.1777	0.2155	0.2248	0.2211	0.2299	0.2299	0.1930	0.2021	0.2205	0.2134	0.2062	0.1838	0.1738	0.1631	0.1624	0.1659	0.1680	0.1703	0.1662
5	0.2574	0.2209	0.2317	0.2662	0.2594	0.2483	0.2508	0.2607	0.2428	0.2483	0.2489	0.2469	0.2375	0.2199	0.2112	0.1949	0.1793	0.1778	0.1863	0.1930	0.1801
6	0.2848	0.2517	0.2459	0.3106	0.2863	0.2868	0.2704	0.2854	0.2726	0.2862	0.2862	0.2803	0.2811	0.2503	0.2307	0.2149	0.2131	0.1992	0.2240	0.2230	0.2192
7	0.3009	0.2648	0.2723	0.3410	0.3454	0.3214	0.3097	0.3169	0.2968	0.3082	0.3304	0.2942	0.2959	0.2715	0.2537	0.2327	0.2295	0.2194	0.2288	0.2383	0.2432
8	0.3408	0.2966	0.2658	0.3758	0.3588	0.3637	0.3406	0.3375	0.3150	0.3317	0.3236	0.3083	0.3244	0.3015	0.2803	0.2366	0.2416	0.2368	0.2567	0.2497	0.2404
9	0.3476	0.3440	0.3038	0.3325	0.3358	0.3954	0.3631	0.3761	0.3419	0.3425	0.3764	0.3307	0.3290	0.3041	0.2905	0.2870	0.2800	0.2687	0.2744	0.2723	0.3037
10	0.3430	0.3343	0.3231	0.2620	0.4223	0.2639	0.3278	0.4055	0.3276	0.3887	0.3975	0.3597	0.3401	0.3188	0.2928	0.2750	0.2889	0.2990	0.2714	0.3024	0.2906
11+	0.3919	0.3823	0.3857	0.2624	0.4364	0.4322	0.4086	0.4348	0.4110	0.4306	0.4095	0.3774	0.3529	0.3543	0.3326	0.3139	0.3223	0.3350	0.3052	0.3229	0.3686
	0.2525	0.2278	0.1979	0.2180	0.2105	0.2163	0.2341	0.2598	0.2495	0.2753	0.2829	0.2808	0.2726	0.2143	0.2381	0.2308	0.2173	0.2026	0.1947	0.2066	0.2095

All Gears

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.0000	0.0328	0.0308	0.0000	0.0000	0.0000	0.0000	0.0000	0.0378	0.0389	0.0690	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.1011	0.1107	0.1110	0.1038	0.1154	0.1381	0.1253	0.1116	0.1142	0.0797	0.0959	0.1054	0.1576	0.0000	0.0661	0.0522	0.0912	0.0854	0.0965	0.0818	0.0729
3	0.1479	0.1567	0.1536	0.1932	0.1889	0.1837	0.2040	0.2083	0.1651	0.2182	0.1805	0.1719	0.1925	0.1520	0.1385	0.1419	0.1373	0.1202	0.1509	0.1480	0.1264
4	0.2229	0.2084	0.1962	0.2369	0.2548	0.2429	0.2445	0.2424	0.2383	0.2411	0.2572	0.2484	0.2414	0.2178	0.2077	0.1862	0.1854	0.1817	0.1991	0.1957	0.2072
5	0.2605	0.2378	0.2574	0.3024	0.2930	0.2740	0.2758	0.2839	0.2734	0.2753	0.2850	0.2837	0.2724	0.2496	0.2455	0.2281	0.2221	0.2083	0.2331	0.2288	0.2261
6	0.2880	0.2619	0.2586	0.3553	0.3311	0.3138	0.3104	0.3212	0.3149	0.3072	0.3167	0.3162	0.3201	0.2916	0.2689	0.2496	0.2519	0.2311	0.2508	0.2551	0.2553
7	0.3033	0.2787	0.2855	0.3823	0.3711	0.3449	0.3428	0.3518	0.3433	0.3367	0.3441	0.3388	0.3434	0.3261	0.2908	0.2635	0.2789	0.2694	0.2664	0.2666	0.2815
8	0.3482	0.3192	0.2712	0.4052	0.3796	0.3651	0.3912	0.3636	0.3626	0.3564	0.3590	0.3399	0.3629	0.3477	0.3321	0.2867	0.3026	0.2863	0.2998	0.2965	0.2882
9	0.3490	0.3544	0.3082	0.3750	0.3763	0.3766	0.4045	0.3974	0.3880	0.3740	0.3952	0.3659	0.3686	0.3546	0.3400	0.3290	0.3345	0.3209	0.3215	0.3163	0.3243
10	0.3436	0.3512	0.3356	0.4032	0.3827	0.4137	0.3762	0.4055	0.3693	0.3858	0.4053	0.3865	0.3871	0.3704	0.3446	0.3014	0.3501	0.3505	0.3473	0.3374	0.3370
11+	0.3976	0.3839	0.3882	0.4208	0.4444	0.4302	0.4747	0.4518	0.4282	0.4259	0.4209	0.3949	0.4018	0.3926	0.3692	0.3364	0.3731	0.3734	0.3890	0.3807	0.3663
	0.2563	0.2373	0.2114	0.2506	0.2680	0.2625	0.2709	0.2968	0.2953	0.3008	0.3091	0.3132	0.3200	0.2662	0.2724	0.2536	0.2753	0.2596	0.2642	0.2449	0.2569

Table 28. Catch-at-age and weight-at-age (kg) for 4T fall spawners caught in 4Vn. Numbers are in thousands of fish.

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0	0	0	0	0	0	0	0	5	20	12	0	0	0	0	0	0	0	0	0	0
2	42	5827	628	377	1868	1352	997	827	604	816	441	26	0	0	0	25	15	14	237	166	0
3	563	2622	2865	541	3147	4652	3551	1987	2533	1613	833	559	697	2105	20	159	280	137	1335	3648	23
4	1601	656	2602	6600	3103	3651	4271	3920	5162	4138	1103	1406	2264	5406	1096	456	1964	551	7966	3134	154
5	1092	167	888	693	1428	2114	2790	2982	2394	1413	3326	1130	1524	2547	3273	1814	722	4374	2560	6276	74
6	842	100	655	591	359	584	775	927	1375	735	2394	2443	413	750	1427	4357	2426	1266	3309	957	23
7	628	324	663	0	156	218	377	590	1770	1040	575	460	2716	856	1474	1687	3193	3844	1657	1560	8
8	366	0	636	206	40	50	66	68	967	820	734	684	642	1266	990	1473	984	3294	1176	561	0
9	449	0	905	236	47	83	58	130	245	185	346	429	857	1309	1379	1594	695	967	887	843	0
10	280	0	638	0	0	0	0	0	75	75	183	123	1686	539	983	1564	829	909	579	519	0
11+	156	0	493	0	57	38	19	48	7	22	79	292	3033	1699	4317	2587	1689	1732	589	635	0
	6019	9696	10973	9444	10227	12742	12904	11477	15137	10657	10028	7554	13832	16477	14959	15716	12797	17088	20295	18299	261

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0380	0.0390	0.0350	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.1930	0.1070	0.1300	0.0800	0.1180	0.1410	0.1260	0.1140	0.0890	0.0750	0.0960	0.1200	0.0000	0.0000	0.0000	0.0280	0.0910	0.0850	0.0850	0.0860	0.0000
3	0.1830	0.1780	0.1650	0.1900	0.1950	0.1900	0.1990	0.2010	0.1480	0.1450	0.1590	0.1640	0.1730	0.1440	0.1320	0.1180	0.1390	0.1280	0.1220	0.1430	0.1285
4	0.2470	0.2280	0.2330	0.2090	0.2360	0.2380	0.2410	0.2470	0.1840	0.1860	0.2090	0.2080	0.2030	0.1920	0.1800	0.1530	0.1610	0.1610	0.1460	0.1688	0.1609
5	0.3040	0.2740	0.3040	0.2810	0.2570	0.2620	0.2660	0.2690	0.2200	0.2110	0.2400	0.2360	0.2240	0.2230	0.2090	0.1780	0.1800	0.1920	0.1650	0.1869	0.1872
6	0.3320	0.2980	0.3370	0.3150	0.2940	0.2960	0.2930	0.2980	0.2540	0.2540	0.2610	0.2740	0.2650	0.2460	0.2380	0.2040	0.2120	0.2130	0.1860	0.2197	0.2357
7	0.3560	0.3480	0.3660	0.0000	0.3250	0.3240	0.3190	0.3170	0.2800	0.2810	0.2940	0.2910	0.2920	0.2630	0.2470	0.2270	0.2300	0.2200	0.2060	0.2239	0.2401
8	0.3740	0.0000	0.3920	0.4280	0.3610	0.3600	0.3540	0.3510	0.2930	0.2970	0.3190	0.3100	0.3150	0.2970	0.2760	0.2460	0.2470	0.2490	0.2280	0.2472	0.0000
9	0.3880	0.0000	0.4000	0.4140	0.3960	0.4050	0.3590	0.3790	0.3280	0.3300	0.3330	0.3410	0.3360	0.3070	0.2860	0.2690	0.2820	0.2670	0.2380	0.2568	0.0000
10	0.3990	0.0000	0.4140	0.0000	0.0000	0.0000	0.0000	0.0000	0.3200	0.3180	0.3520	0.3370	0.3420	0.3210	0.2850	0.2830	0.2990	0.2900	0.2630	0.2913	0.0000
11+	0.4290	0.0000	0.4350	0.0000	0.4210	0.4190	0.4080	0.4210	0.4460	0.3920	0.3700	0.3480	0.3470	0.3540	0.3300	0.3110	0.3240	0.3390	0.3220	0.3464	0.0000
	0.3050	0.1460	0.2720	0.2250	0.2100	0.2200	0.2330	0.2460	0.2050	0.1960	0.2430	0.2590	0.2850	0.2350	0.2640	0.2370	0.2320	0.2340	0.1750	0.1944	0.1734

Table 29. Catch-at-age for 4T spring spawners, including those caught in 4Vn. Numbers are in thousands of fish.

Fixed Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0	425	0	14	10	0	0	0	0	0	59	0	0	0	53	0	0	0	0	0	0
2	14	198	169	394	162	248	64	330	10	271	501	0	104	65	619	6	0	0	0	1	0
3	5644	6922	10538	13093	23717	16174	4538	6009	3593	1684	4012	4093	2897	6293	2725	280	1817	331	320	155	1187
4	25469	3140	6746	8353	4509	25937	13994	15844	18110	8051	8626	16434	14297	12101	30568	6477	5278	12469	1511	5456	8735
5	1255	17307	2632	2888	1066	2097	6044	14353	12735	22119	11447	6223	10323	14809	11750	37705	26443	11120	46691	4213	16037
6	1831	641	8501	1818	493	460	376	5196	11482	11213	15722	6114	3415	9180	7680	17143	47296	16846	8154	37461	2303
7	1391	1242	1824	3363	323	102	58	1304	2932	6669	9255	7153	3074	3488	3497	6448	9030	24526	13512	7905	30757
8	259	274	942	486	337	0	49	696	444	3676	7012	4491	4865	3201	1745	2676	4437	4948	9769	5149	3563
9	447	136	851	454	123	0	4	61	32	516	1651	2635	2609	4764	1886	1954	1196	2003	3399	3789	2339
10	1375	302	462	195	91	0	5	0	130	331	89	901	1000	2261	1888	1614	1225	1029	989	1267	1982
11+	1496	1454	699	961	571	0	0	1	205	162	530	283	265	1138	1738	2023	1599	2068	1598	249	864
Total	39181	32041	33364	31819	31402	45018	27152	43796	49673	56692	58904	48327	42849	57300	64151	76326	98323	75359	85943	65666	67768

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	1479	12367	965	595	1525	302	522	826	167	73	2447	332	38	0	61	17	0	0	0	43	4
2	15379	14047	10852	4683	3790	4120	1850	1963	2362	409	4987	396	3463	1372	862	741	39	995	272	410	327
3	5909	16513	13124	3136	2821	5201	1969	2619	5218	1224	1515	1650	3521	4682	2742	597	3085	1235	3273	1516	737
4	16315	12113	12773	137	715	1519	1480	2090	5536	1966	1005	2100	2574	2481	4719	1968	2269	10147	2018	3505	1256
5	2673	12527	5335	443	372	462	815	998	3132	4683	1362	856	2079	1378	2328	3520	5807	4633	10131	956	862
6	4929	3627	6435	101	6	1	20	511	2634	3889	4768	2317	1165	771	1754	2620	6184	5268	3908	4739	377
7	5128	1772	3526	229	4	16	0	58	719	3148	2874	4075	715	674	374	1285	2015	7577	2695	345	1586
8	1303	1672	1783	389	19	36	15	0	495	1225	2411	1768	1925	1355	329	764	1886	1724	1837	891	549
9	1328	411	1260	1	67	0	0	113	194	0	1617	1413	1034	336	453	1283	641	504	297	713	552
10	1107	145	295	252	1	0	0	0	0	0	0	428	425	364	342	1360	326	932	562	200	473
11+	5628	1450	340	3	8	0	0	145	45	37	570	23	176	344	250	1621	611	1237	357	349	513
Total	61178	76644	56708	9969	9328	11657	6691	9323	20502	16654	23556	15358	17115	13757	14214	15756	25063	34252	25349	13868	7235

All Gears

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	1479	12792	965	609	1535	302	522	826	167	73	2506	332	38	0	114	17	0	0	0	43	4
2	15393	14245	11021	5077	3952	4368	1934	2293	2372	680	5488	396	3567	1437	1481	747	39	995	272	411	327
3	11553	23435	23662	16229	26538	21375	6527	8628	8811	2908	5527	5743	6418	10975	5467	877	4902	1566	3593	1671	1924
4	41784	15253	19519	8490	5224	27456	15474	17934	23646	10017	9631	18534	16871	14582	35287	8445	7547	22616	3529	8961	9991
5	3928	29834	7967	3131	1438	2559	8859	15351	15867	26802	12809	7079	12402	16187	14078	41225	32250	15753	56822	5169	16899
6	6760	4268	14936	1919	499	461	396	5709	14116	15102	20490	8431	4580	9951	9434	19763	55480	22114	12061	42201	2680
7	6519	3014	5350	3592	327	118	58	1362	3651	11817	12129	11228	3789	4162	3871	7713	11045	32102	16207	8250	32343
8	1562	1946	2725	875	356	36	64	696	939	4901	9423	6259	6790	4556	2074	3440	6323	6672	11606	6040	4112
9	1775	547	2131	455	190	0	4	174	226	516	3268	4048	3643	5100	2341	3237	1839	2507	3696	4503	2891
10	2482	447	757	447	92	0	5	0	130	331	89	1329	1425	2625	2230	2974	1551	1960	1551	1488	2455
11+	7124	2904	1039	964	579	0	0	146	250	199	1100	306	441	1482	1988	3644	2410	3325	1955	598	1377
Total	100359	108685	90072	41788	40730	56675	33843	53119	70175	73346	82460	63685	59964	71057	78365	92082	123386	109611	111292	79335	75003

Table 30. Weight-at-age (kg) for 4T spring spawners, including those caught in 4Vn.

Fixed Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.0000	0.0195	0.0000	0.1005	0.0366	0.0000	0.0000	0.0000	0.0000	0.0000	0.0379	0.0000	0.0000	0.0000	0.0501	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.1418	0.1608	0.1816	0.1397	0.1953	0.1721	0.0933	0.2132	0.1073	0.1513	0.0798	0.0000	0.1495	0.1483	0.1111	0.1240	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.1478	0.1698	0.1674	0.1834	0.1745	0.1554	0.1764	0.1836	0.1603	0.1880	0.1605	0.1658	0.1599	0.1452	0.1421	0.1405	0.1494	0.1242	0.1374	0.1376	0.1312
4	0.1888	0.2139	0.1861	0.2358	0.2105	0.2084	0.1957	0.2161	0.1959	0.1959	0.2031	0.2019	0.1957	0.1812	0.1710	0.1667	0.1546	0.1597	0.1728	0.1616	0.1596
5	0.2109	0.2291	0.2284	0.2648	0.2640	0.2423	0.2137	0.2456	0.2419	0.2175	0.2402	0.2315	0.2242	0.2182	0.2002	0.1864	0.1773	0.1830	0.1730	0.1799	0.1650
6	0.2562	0.2441	0.2691	0.3269	0.3171	0.2675	0.2683	0.2789	0.2561	0.2520	0.2662	0.2552	0.2584	0.2437	0.2309	0.2069	0.1965	0.2037	0.1892	0.1997	0.2054
7	0.3221	0.3046	0.3067	0.3362	0.3717	0.3269	0.3029	0.3499	0.3194	0.2705	0.2675	0.2607	0.2640	0.2576	0.2537	0.2395	0.2183	0.2200	0.2096	0.2119	0.2195
8	0.3076	0.3362	0.3319	0.3393	0.3794	0.0000	0.3843	0.3705	0.3392	0.2781	0.3038	0.2939	0.2885	0.2855	0.2601	0.2505	0.2567	0.2397	0.2330	0.2314	0.2364
9	0.3114	0.3430	0.3678	0.3767	0.4026	0.0000	0.4429	0.4001	0.3486	0.2959	0.3233	0.3124	0.3060	0.2992	0.2886	0.2747	0.2942	0.2768	0.2360	0.2464	0.2461
10	0.3306	0.3174	0.3630	0.3986	0.4060	0.0000	0.3713	0.0000	0.3159	0.2964	0.3754	0.3238	0.3072	0.3041	0.3015	0.2864	0.2944	0.2847	0.2818	0.2400	0.2580
11+	0.3671	0.3529	0.3731	0.4082	0.4460	0.0000	0.0000	0.4913	0.4181	0.3913	0.3367	0.2978	0.3306	0.3208	0.3196	0.2949	0.3212	0.3190	0.3037	0.2902	0.2718
Total	0.2054	0.2227	0.2264	0.2428	0.1957	0.1916	0.1991	0.2354	0.2289	0.2338	0.2531	0.2385	0.2306	0.2247	0.1999	0.2031	0.1983	0.2069	0.1931	0.1934	0.2053

Mobile Gear

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.0787	0.0967	0.1070	0.1057	0.0995	0.1183	0.0991	0.0886	0.0650	0.0571	0.0810	0.0882	0.0789	0.0000	0.0511	0.0587	0.0000	0.0000	0.0704	0.0604	0.0756
2	0.1305	0.1520	0.1532	0.1794	0.1607	0.1635	0.1678	0.1632	0.1293	0.1518	0.1132	0.1716	0.1724	0.1417	0.1190	0.1157	0.1456	0.0889	0.1131	0.1151	0.1126
3	0.1817	0.1483	0.1618	0.2233	0.2186	0.1950	0.2183	0.2166	0.1678	0.1703	0.1740	0.2131	0.1990	0.1767	0.1471	0.1370	0.1513	0.1310	0.1595	0.1490	0.1504
4	0.2523	0.1774	0.2141	0.2389	0.2512	0.2290	0.2369	0.2415	0.2365	0.2541	0.2367	0.2516	0.2437	0.1969	0.1995	0.1749	0.1778	0.1764	0.1812	0.1921	0.1791
5	0.2556	0.2486	0.2470	0.3678	0.2886	0.2933	0.2742	0.2971	0.2816	0.2972	0.3044	0.2626	0.2789	0.2335	0.2439	0.1893	0.1955	0.1976	0.2174	0.2090	0.2241
6	0.2822	0.2513	0.2731	0.4102	0.3241	0.2731	0.3031	0.3112	0.3070	0.3282	0.3226	0.3126	0.2968	0.2628	0.2729	0.2242	0.2218	0.2254	0.2256	0.2431	0.2287
7	0.3026	0.2820	0.2833	0.3266	0.3796	0.2455	0.0000	0.2824	0.3241	0.3375	0.3588	0.3410	0.3365	0.2889	0.2806	0.2628	0.2640	0.2489	0.2356	0.2401	0.2570
8	0.3040	0.3122	0.2812	0.2846	0.3337	0.2375	0.3189	0.0000	0.3003	0.3671	0.3889	0.3496	0.3214	0.2909	0.3068	0.3308	0.2570	0.2701	0.2656	0.2780	0.2634
9	0.3139	0.3525	0.3377	0.3639	0.3221	0.0000	0.0000	0.5884	0.2910	0.0000	0.4024	0.3671	0.3435	0.3392	0.3332	0.3655	0.2988	0.2928	0.3153	0.3145	0.3071
10	0.3759	0.3115	0.3820	0.3251	0.4326	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3829	0.3927	0.3412	0.3412	0.3082	0.3274	0.3329	0.3086	0.3257	0.3320
11+	0.3618	0.3917	0.3589	0.4081	0.4472	0.0000	0.0000	0.3466	0.3933	0.5328	0.4281	0.3838	0.3268	0.3509	0.3731	0.3254	0.3330	0.3073	0.3417	0.3641	0.4026
Total	0.2322	0.1792	0.2060	0.2116	0.1822	0.1904	0.2064	0.2203	0.2267	0.2987	0.2581	0.3012	0.2510	0.2162	0.2156	0.2391	0.2159	0.2141	0.2175	0.2235	0.2401

All Gears

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.0787	0.0941	0.1070	0.1056	0.0991	0.1183	0.0991	0.0886	0.0650	0.0571	0.0800	0.0882	0.0789	0.0000	0.0506	0.0587	0.0000	0.0000	0.0704	0.0604	0.0756
2	0.1305	0.1521	0.1537	0.1763	0.1621	0.1640	0.1645	0.1704	0.1292	0.1516	0.1102	0.1716	0.1717	0.1420	0.1157	0.1158	0.1456	0.0889	0.1131	0.1148	0.1126
3	0.1651	0.1546	0.1643	0.1911	0.1792	0.1650	0.169[illegible]	0.1936	0.1647	0.1605	0.1642	0.1794	0.1814	0.1586	0.1447	0.1361	0.1506	0.1296	0.1575	0.1479	0.1365
4	0.2136	0.1849	0.2044	0.2359	0.2160	0.2096	0.1997	0.2190	0.2054	0.2073	0.2066	0.2075	0.2031	0.1839	0.1748	0.1666	0.1615	0.1672	0.1776	0.1735	0.1622
5	0.2414	0.2373	0.2409	0.2966	0.2703	0.2515	0.2193	0.2490	0.2497	0.2314	0.2470	0.2353	0.2334	0.2195	0.2075	0.1866	0.1805	0.1873	0.1809	0.1853	0.1870
6	0.2752	0.2502	0.2708	0.3313	0.3172	0.2675	0.2701	0.2818	0.2656	0.2716	0.2793	0.2710	0.2687	0.2444	0.2387	0.2092	0.2020	0.2089	0.2010	0.2046	0.2087
7	0.3068	0.2913	0.2781	0.3357	0.3718	0.3159	0.3029	0.3470	0.3203	0.2883	0.3044	0.3026	0.2777	0.2627	0.2563	0.2433	0.2267	0.2268	0.2140	0.2130	0.2214
8	0.3046	0.3158	0.2987	0.3150	0.3770	0.2375	0.3690	0.3705	0.3187	0.3003	0.3256	0.3096	0.2978	0.2871	0.2675	0.2684	0.2568	0.2476	0.2381	0.2382	0.2418
9	0.3132	0.3501	0.3497	0.3787	0.3742	0.0000	0.4429	0.5224	0.2992	0.2959	0.3624	0.3315	0.3187	0.3019	0.2972	0.3107	0.2958	0.2800	0.2424	0.2572	0.2577
10	0.3509	0.3155	0.3704	0.3572	0.4063	0.0000	0.3713	0.0000	0.3159	0.2964	0.3754	0.3428	0.3327	0.3093	0.3076	0.2964	0.3013	0.3076	0.2915	0.2516	0.2722
11+	0.3629	0.3723	0.3685	0.4082	0.4460	0.0000	0.0000	0.3476	0.4136	0.4176	0.3841	0.3043	0.3299	0.3278	0.3265	0.3085	0.3252	0.3146	0.3106	0.3333	0.3205
Total	0.2217	0.1920	0.2148	0.2354	0.1926	0.1914	0.2006	0.2328	0.2282	0.2485	0.2546	0.2536	0.2364	0.2231	0.2027	0.2093	0.2019	0.2091	0.1987	0.1988	0.2087

Table 31. Catch-at-age and weights-at-age (kg) for 4T spring spawners caught in 4Vn. Numbers are in thousands of fish.

Mobile Gear – Numbers-at-age

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	58	5679	349	595	1525	302	522	615	117	73	0	0	8	0	0	16	0	0	0	20	0
2	809	5007	2614	2829	3074	3383	1759	953	929	226	214	0	218	167	28	43	35	36	72	61	6
3	978	383	901	1833	1994	1561	1702	1129	4064	827	132	105	552	108	11	27	474	13	551	88	0
4	358	0	143	0	667	526	636	636	1466	441	145	160	608	990	74	51	187	289	209	37	0
5	330	0	117	436	362	289	371	416	0	0	127	99	701	269	182	176	138	104	1442	19	0
6	455	296	277	0	0	0	0	0	265	64	0	219	333	134	573	265	208	113	932	158	0
7	0	0	0	0	0	0	0	0	0	0	59	0	218	361	0	150	183	141	79	10	0
8	114	0	43	0	0	0	0	0	413	67	29	109	35	1157	0	120	53	27	27	43	0
9	14	0	17	0	0	0	0	0	0	0	0	0	47	186	0	0	83	4	96	116	0
10	0	0	0	0	0	0	0	0	0	0	0	0	99	186	0	0	0	8	4	31	0
11+	32	0	55	0	0	0	0	0	0	0	0	0	0	194	148	0	0	20	64	51	0
Total	3148	11367	4516	5695	7622	6061	4990	3751	7254	1698	706	712	2819	3792	1016	848	1361	755	3477	631	15

Mobile Gear – Weight-at-age

AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	0.071	0.097	0.110	0.106	0.100	0.118	0.099	0.090	0.056	0.057	0.000	0.000	0.079	0.000	0.000	0.059	0.000	0.000	0.070	0.0695	0.0000
2	0.174	0.154	0.156	0.182	0.166	0.168	0.169	0.168	0.121	0.121	0.123	0.000	0.157	0.094	0.140	0.099	0.151	0.108	0.103	0.0957	0.1192
3	0.228	0.181	0.215	0.230	0.221	0.220	0.224	0.234	0.156	0.158	0.181	0.145	0.217	0.113	0.179	0.163	0.149	0.126	0.136	0.1401	0.0000
4	0.290	0.000	0.275	0.000	0.252	0.254	0.257	0.263	0.192	0.188	0.198	0.177	0.242	0.181	0.207	0.222	0.195	0.177	0.183	0.1911	0.0000
5	0.323	0.000	0.314	0.369	0.289	0.301	0.300	0.313	0.000	0.000	0.242	0.213	0.279	0.228	0.243	0.233	0.187	0.199	0.221	0.1958	0.0000
6	0.370	0.364	0.383	0.000	0.000	0.000	0.000	0.000	0.228	0.228	0.000	0.274	0.280	0.245	0.294	0.269	0.220	0.218	0.228	0.2447	0.0000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.287	0.000	0.319	0.265	0.000	0.296	0.296	0.241	0.265	0.2771	0.2892
8	0.363	0.000	0.387	0.000	0.000	0.000	0.000	0.000	0.293	0.294	0.390	0.279	0.279	0.282	0.000	0.342	0.254	0.239	0.324	0.2859	0.0000
9	0.480	0.000	0.483	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.360	0.335	0.000	0.000	0.296	0.321	0.310	0.3151	0.0000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.341	0.335	0.000	0.000	0.000	0.317	0.314	0.3129	0.0000
11+	0.433	0.000	0.441	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.329	0.392	0.000	0.000	0.314	0.318	0.3621	0.0000
Total	0.257	0.132	0.193	0.204	0.180	0.193	0.201	0.207	0.167	0.165	0.195	0.223	0.256	0.243	0.287	0.256	0.203	0.202	0.211	0.2479	0.2249

Table 32. Agreement in aging between original and test ages.

	Test Ages												
Original Age	0	1	2	3	4	5	6	7	8	9	10	11	Total
0	10	0	0	0	0	0	0	0	0	0	0	0	10
1	0	7	1	0	0	0	0	0	0	0	0	0	8
2	0	0	17	0	0	0	0	0	0	0	0	0	17
3	0	0	0	11	0	0	0	0	0	0	0	0	11
4	0	0	0	1	18	0	0	0	0	0	0	0	19
5	0	0	0	0	3	15	0	0	0	0	0	0	18
6	0	0	0	0	0	4	22	1	0	0	0	0	27
7	0	0	0	0	0	0	1	5	1	0	0	0	7
8	0	0	0	0	0	0	0	2	6	4	0	0	12
9	0	0	0	0	0	0	0	0	2	15	1	2	20
10	0	0	0	0	0	0	0	0	0	3	1	2	6
11	0	0	0	0	0	0	0	0	0	1	1	9	11
Total	10	7	18	12	21	19	23	8	9	23	3	13	166

Table 33. Results from mulitplicative model of spring spawners CUE for weeks 2-7.

Model: MODEL1
Dependent Variable: CPUE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	14	217.60873	15.54348	16.015	0.0001
Error	448	434.80055	0.97054		
C Total	462	652.40928			

Root MSE	0.98516	R-square	0.3335
Dep Mean	4.56211	Adj R-sq	0.3127
C.V.	21.59434		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	5.617676	0.14718638	38.167	0.0001
YY90	1	-1.122700	0.24128287	-4.653	0.0001
YY91	1	-0.483164	0.19060460	-2.535	0.0116
YY92	1	-0.325548	0.18474613	-1.762	0.0787
YY93	1	-0.225246	0.17653652	-1.276	0.2026
YY95	1	-0.507799	0.18559129	-2.736	0.0065
YY96	1	-0.738299	0.19194205	-3.846	0.0001
YY97	1	-0.036149	0.15236260	-0.237	0.8126
YY98	1	-0.239167	0.20660427	-1.158	0.2476
A2	1	-1.126793	0.09254623	-12.175	0.0001
W2	1	-0.876654	0.20007565	-4.382	0.0001
W3	1	-0.185161	0.13067618	-1.417	0.1572
W5	1	-0.260137	0.13416562	-1.924	0.0550
W6	1	-0.268055	0.16120634	-1.663	0.0971
W7	1	0.491488	0.28918855	1.700	0.0899

Table 34. Catch by week (10-day period) as used in the multiplicative catch rate model for spring spawners using data from Escuminac and southeast New Brunswick. Figures in bold represent the week with the highest catch rates.

Escuminac

	Week by Date and Number Code						
	Ap20-29	Ap 30-May 9	May 10-19	May 20-29	May 30-June8	June 9-19	
Year	2	3	4	5	6	7	Grand Total
90		**660**	569				1229
91		1540	**2732**	478	7		4757
92		534	**1980**	1463	175		4151
93		368	**1642**	632	88		2731
94	342	1111	**2057**	1119	816	1498	**6943**
95		33	**1733**	1164	538		3468
96	20	738	**1195**	202			2155
97	31	1459	**1994**	442	221	7	4153
98	307	**3735**	372				4414
Total	700	10178	**14274**	5500	1845	1504	

Southeast New Brunswick

	Week by Date and Number Code						
	Ap20-29	Ap 30-May 9	May 10-19	May 20-29	May 30-June8	June 9-19	
Year	2	3	4	5	6	7	Grand Total
90		**1504**	244				1747
91		165	**767**	358	51		1341
92			372	**579**	285	103	1339
93		**1066**	951	544	239		2801
94	1955	**1994**	774	178	111		**5012**
95			**1508**	234			1741
96	285	**1906**	845	209			3245
97	27	**2394**	205	117	76	16	2835
98	147	**1681**	222		18	121	2188
Total	2413	**10710**	5886	2219	780	240	

Table 35. CUE catch rate index by age for spring spawners, used in ADAPT-VPA population models. The purpose of the 0.4 designation in year indicates that the index relates to that proportion of the year.

	Age						
Year	4	5	6	7	8	9	10
1990.4	205	148	49	44	70	37	14
1991.4	256	313	194	74	68	101	48
1992.4	758	291	190	87	43	47	47
1993.4	147	856	389	146	61	44	37
1994.4	120	601	1074	205	101	27	28
1995.4	213	190	287	418	84	34	18
1996.4	19	591	103	171	124	43	13
1997.4	175	135	1203	254	165	122	41
1998.4	217	398	57	763	88	58	49

Table 36. Results from multiplicative model for spring catch rates which includes an area by week interaction effect.

General Linear Models Procedure

Dependent Variable: CPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	19	274.00603168	14.42137009	16.88	0.0001
Error	443	378.40324980	0.85418341		
Corrected Total	462	652.40928148			

R-Square	C.V.	Root MSE	CPUE Mean
0.419991	20.25860	0.92422043	4.56211292

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YC	8	42.74604932	5.34325617	6.26	0.0001
AC	1	147.54205406	147.54205406	172.73	0.0001
WC	5	27.32062589	5.46412518	6.40	0.0001
AC*WC	5	56.39730241	11.27946048	13.20	0.0001

Source	DF	Type II SS	Mean Square	F Value	Pr > F
YC	8	38.12373472	4.76546684	5.58	0.0001
AC	1	143.87428684	143.87428684	168.43	0.0001
WC	5	27.32062589	5.46412518	6.40	0.0001
AC*WC	5	56.39730241	11.27946048	13.20	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YC	8	38.12373472	4.76546684	5.58	0.0001
AC	1	72.21343991	72.21343991	84.54	0.0001
WC	5	30.09278493	6.01855699	7.05	0.0001
AC*WC	5	56.39730241	11.27946048	13.20	0.0001

Source	DF	Type IV SS	Mean Square	F Value	Pr > F
YC	8	38.12373472	4.76546684	5.58	0.0001
AC	1	72.21343991	72.21343991	84.54	0.0001
WC	5	30.09278493	6.01855699	7.05	0.0001
AC*WC	5	56.39730241	11.27946048	13.20	0.0001

Table 36. (cont.).

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		5.882453556 B	37.70	0.0001	0.15605096
YC	90	-1.171982823 B	-5.16	0.0001	0.22732082
	91	-0.481117413 B	-2.68	0.0077	0.17977060
	92	-0.173332083 B	-0.98	0.3271	0.17669449
	93	-0.199504769 B	-1.20	0.2313	0.16650991
	95	-0.484869551 B	-2.76	0.0061	0.17591773
	96	-0.733806039 B	-4.06	0.0001	0.18096116
	97	-0.072850010 B	-0.50	0.6140	0.14433092

.....

Dependent Variable: CPUE

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
YC	98	-0.203852263 B	-1.01	0.3112	0.20105618
	940	0.000000000 B	.	.	.
AC	2	-1.675192201 B	-9.99	0.0001	0.16766329
	10	0.000000000 B	.	.	.
WC	2	-1.623831282 B	-5.95	0.0001	0.27269619
	3	-0.929396932 B	-5.58	0.0001	0.16649786
	5	-0.258194377 B	-1.49	0.1374	0.17350405
	6	-0.422959185 B	-2.03	0.0432	0.20857695
	7	0.352314455 B	0.87	0.3836	0.40398792
	40	0.000000000 B	.	.	.
AC*WC	2 2	1.392261730 B	3.90	0.0001	0.35736851
	2 3	1.569887842 B	6.58	0.0001	0.23874507
	2 5	-0.036997322 B	-0.15	0.8795	0.24383295
	2 6	0.261683637 B	0.90	0.3710	0.29220086
	2 7	0.277641532 B	0.51	0.6115	0.54627800
	2 40	0.000000000 B	.	.	.
	10 2	0.000000000 B	.	.	.
	10 3	0.000000000 B	.	.	.
	10 5	0.000000000 B	.	.	.
	10 6	0.000000000 B	.	.	.
	10 7	0.000000000 B	.	.	.
	10 40	0.000000000 B	.	.	.

Table 37. Acoustic survey areas and dates and proportion of transects covered during night hours (PN). Transceiver for all years was Simrand EY200. A ball calibration was completed in all years except 1991. In 1991, the calibration from 1992 was used. From 1994 to 1998 all transects have been done during night hours (1900-0700). The strata surveyed in each area have not been consistent each year. To see which strata are surveyed each year, individual reports must be consulted.

	91		92		93		94	95	96	97	98
Area	Date	PN	Date	PN	Date	PN					
Chaleur-Miscou	Oct. 10-19	53	Oct. 1-15	54	Oct. 2-14	56	Oct. 16-28	Sep 30 – Oct. 8	Sep 24 – Oct. 5	Sep 21-28	Sep 19-30
Tracadie								Sep 28-29	Oct. 6-7	Sep 28-29	
North PEI									Oct. 8-10	Oct. 2-4	
Milne Bank			Oct. 16	63	Oct. 15	40		Sep 23	Oct. 10	Oct. 4	
NS – East PEI								Sep 23-24	Oct. 10-13		
Magdalen Is.										Oct. 5-7	
Cape Breton	Oct. 22-24	61	Oct. 16-22	46	Oct 15-20	53		Sep 25-27	Oct 14-16	Oct 9-11	Oct 7-10
Vessels	A. Needler		E.E. Prince		A. Needler		F. Creed and J.L. Hart	F. Creed and Calanus II Hull	F. Creed and Calanus II Hull	F. Creed and Calanus II Hull	F. Creed and Calanus II Hull
Transducer mount	Towed body and cable		Towed body and cable		Towed body and cable		Torpedo between hulls				
Problems and changes	Towed body cable caught in bouey, spliced and repaired. Motherboard in EY200 replaced		Prior to survey, motherboard in EY200 replaced		Replacement of faulty power supply in EY200						Shorter transects Gaspe + G. Riv + NE, SE Misc + C. Breton. New smaller midwater trawl.

Table 38. Biomass indices from major areas of acoustic survey for spring and fall spawners. See Table 37 for areas that were done each year.

	Biomass Index (t)									Percentage in each area								
Area	90	91	92	93	94	95	96	97	98	90	91	92	93	94	95	96	97	98
Fall Spawners																		
Chaleur-Miscou	302765	27158	102836	74552	122008	43300	134003	107458	50684	70.9	86.1	70.5	86.6	100	87.4	70.4	65.7	54.3
North P.E.I.	ns	ns	ns	ns	ns	ns	35115	38912	ns	ns	ns	ns	ns	ns	ns	18.5	23.8	ns
Cape Breton	124429	4374	43051	11511	ns	6254	21093	17114	42631	29.1	13.9	29.5	13.4	ns	12.6	11.1	10.5	45.7
Total	427194	31532	145888	86063	122008	49554	190211	163484	93315									
Spring Spawners																		
Chaleur-Miscou	643376	12780	42004	43784	57415	20376	89332	66596	60087	98.3	99.7	95.9	97.8	100	95.7	88.7	79.8	97.5
North P.E.I.	ns	ns	ns	ns	ns	ns	10562	16518	ns	ns	ns	ns	ns	ns	ns	10.5	19.8	ns
Cape Breton	10820	44	1794	1001	ns	913	777	349	1564	1.7	0.3	4.1	2.2	ns	4.3	0.8	0.4	2.5
Total	654196	12824	43797	44785	57415	21289	100671	83463	61651									

Table 39. Acoustic survey same strata coverage, fall and spring spawner numbers-at-age (x 1000) in Chaleur – Miscou strata.

Fall Spawners

Age	1994	1995	1996	1997	1998
0	0	0	0	0	0
1	3962	59	29739	0	0
2	2950	16977	104533	155032	62339
3	8997	22111	113177	231524	129460
4	333790	12927	213907	175468	40101
5	105154	91421	36016	75343	33932
6	101952	17178	114055	15356	13925
7	104507	36164	23120	40463	4690
8	13266	35111	8826	18301	14347
9	7096	4557	14376	13442	2883
10	0	956	7924	7154	5553
11	4466	487	0	3419	2295
Total	686140	237949	665674	735503	309525
4+	670230	198802	418226	348946	117726

Spring Spawners

Age	1994	1995	1996	1997	1998
0	28557	186	43891	0	18591
1	736	17561	33927	9549	29542
2	3927	57445	269798	104184	184347
3	140874	6338	94420	67787	26545
4	55287	34369	17820	62523	23397
5	47146	2623	74019	5245	12863
6	40883	13666	3713	82462	5094
7	10046	8205	12273	14769	37471
8	556	2884	5061	14441	7241
9	3538	1242	0	14029	2949
10	1673	0	0	0	3994
11	1738	0	0	0	1098
Total	334959	144520	554921	374990	353133
4+	160865	62991	112886	193469	94107

Table 40. ADAPT-VPA (F-OLD) results for spring using New Brunswick catch rates 1990-1998.

approximate statistics assuming linearity near solution

orthogonality offset 0.00247

mean square residuals 0.19971

	par est	std err	cv	t-stat	% bias
4	148790.277	73555.0524	0.494354	2.022842	12.576741
5	83129.9561	32689.9990	0.393240	2.542978	7.448079
6	9808.78729	3750.29454	0.382340	2.615471	6.314717
7	74227.9882	29179.7869	0.393110	2.543815	5.954912
8	12386.7066	4672.17964	0.377193	2.651162	5.368907
9	10912.8694	4018.05431	0.368194	2.715959	5.092694
10	10025.4823	3586.15226	0.357764	2.795610	4.767479
4	0.001256	0.000214	0.170490	5.865430	0.772837
5	0.003869	0.000630	0.162805	6.142311	0.829456
6	0.004737	0.000761	0.160664	6.224164	0.970946
7	0.005303	0.000847	0.159706	6.261494	1.122335
8	0.004947	0.000786	0.158897	6.293401	1.260361
9	0.005052	0.000792	0.156702	6.381521	1.326338
10	0.005525	0.000846	0.153172	6.528601	1.281100

parameter correltion matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.00	0.10	0.08	0.06	0.05	0.04	0.02	-0.36	-0.05	-0.04	-0.03	-0.02	-0.01	-0.01
2	0.10	1.00	0.11	0.09	0.07	0.05	0.04	-0.27	-0.29	-0.06	-0.04	-0.03	-0.02	-0.01
3	0.08	0.11	1.00	0.12	0.09	0.07	0.05	-0.21	-0.24	-0.27	-0.06	-0.04	-0.02	-0.01
4	0.06	0.09	0.12	1.00	0.12	0.09	0.06	-0.18	-0.19	-0.22	-0.27	-0.05	-0.03	-0.01
5	0.05	0.07	0.09	0.12	1.00	0.11	0.08	-0.14	-0.16	-0.18	-0.22	-0.26	-0.04	-0.02
6	0.04	0.05	0.07	0.09	0.11	1.00	0.11	-0.10	-0.11	-0.13	-0.17	-0.22	-0.25	-0.02
7	0.02	0.04	0.05	0.06	0.08	0.11	1.00	-0.07	-0.08	-0.09	-0.13	-0.17	-0.21	-0.23
8	-0.36	-0.27	-0.21	-0.18	-0.14	-0.10	-0.07	1.00	0.15	0.11	0.08	0.06	0.04	0.02
9	-0.05	-0.29	-0.24	-0.19	-0.16	-0.11	-0.08	0.15	1.00	0.12	0.09	0.07	0.04	0.02
10	-0.04	-0.06	-0.27	-0.22	-0.18	-0.13	-0.09	0.11	0.12	1.00	0.11	0.08	0.05	0.02
11	-0.03	-0.04	-0.06	-0.27	-0.22	-0.17	-0.13	0.08	0.09	0.11	1.00	0.10	0.06	0.03
12	-0.02	-0.03	-0.04	-0.05	-0.26	-0.22	-0.17	0.06	0.07	0.08	0.10	1.00	0.08	0.04
13	-0.01	-0.02	-0.02	-0.03	-0.04	-0.25	-0.21	0.04	0.04	0.05	0.06	0.08	1.00	0.05
14	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.23	0.02	0.02	0.02	0.03	0.04	0.05	1.00

Table 41. Parameter estimates from ADAPT-VPA FRATIO model using CUE index for spring spawners.

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.000445
MEAN SQUARE RESIDUALS 0.200312

Estimates for parameters

PAR. EST.	STD. ERR.	REL. ERR.	BIAS	REL. BIAS
1.19E1	4.97E-1	0.042	8.60E-3	0.001
1.13E1	3.98E-1	0.035	3.44E-3	0.000
9.16E0	3.89E-1	0.042	-1.26E-3	0.000
1.12E1	4.03E-1	0.036	-6.00E-3	-0.001
9.39E0	3.89E-1	0.041	-2.44E-3	0.000
9.25E0	3.84E-1	0.042	2.21E-3	0.000
9.55E0	3.58E-1	0.038	3.24E-2	0.003
4.11E-1	4.94E-1	1.201	2.65E-2	0.064
-6.67E0	1.72E-1	-0.026	-1.23E-2	0.002
-5.55E0	1.65E-1	-0.030	-1.16E-2	0.002
-5.34E0	1.64E-1	-0.031	-1.19E-2	0.002
-5.23E0	1.65E-1	-0.031	-1.24E-2	0.002
-5.29E0	1.68E-1	-0.032	-1.37E-2	0.003
-5.26E0	1.74E-1	-0.033	-1.66E-2	0.003
-5.12E0	1.98E-1	-0.039	-2.48E-2	0.005

Parameters in linear scale

PAR. EST.	STD. ERR.	REL. ERR.	BIAS	REL. BIAS
1.46E5	7.27E4	0.497	1.93E4	0.132
8.13E4	3.23E4	0.398	6.71E3	0.082
9.55E3	3.71E3	0.389	7.10E2	0.074
7.20E4	2.90E4	0.403	5.41E3	0.075
1.20E4	4.65E3	0.389	8.75E2	0.073
1.04E4	4.01E3	0.384	7.94E2	0.076
1.40E4	5.02E3	0.358	1.35E3	0.097
1.51E0	7.45E-1	0.494	2.24E-1	0.148
1.27E-3	2.19E-4	0.172	3.22E-6	0.003
3.90E-3	6.44E-4	0.165	7.95E-6	0.002
4.78E-3	7.82E-4	0.164	7.02E-6	0.001
5.35E-3	8.81E-4	0.165	5.94E-6	0.001
5.02E-3	8.42E-4	0.168	1.80E-6	0.000
5.22E-3	9.10E-4	0.174	-7.42E-6	-0.001
5.95E-3	1.18E-3	0.198	-3.06E-5	-0.005

Table 42. Parameter correlations from ADAPT-VPA spring spawner FRATIO model.

1.00	0.10	0.08	0.07	0.06	0.05	0.06	-0.03	-0.36	-0.06	-0.05	-0.04	-0.04	-0.03	-0.03
0.10	1.00	0.12	0.10	0.08	0.07	0.08	-0.04	-0.28	-0.30	-0.07	-0.06	-0.05	-0.05	-0.05
0.08	0.12	1.00	0.13	0.11	0.09	0.11	-0.04	-0.22	-0.25	-0.29	-0.08	-0.07	-0.06	-0.06
0.07	0.10	0.13	1.00	0.14	0.11	0.14	-0.06	-0.19	-0.21	-0.24	-0.29	-0.09	-0.08	-0.08
0.06	0.08	0.11	0.14	1.00	0.15	0.18	-0.08	-0.16	-0.18	-0.20	-0.25	-0.30	-0.11	-0.11
0.05	0.07	0.09	0.11	0.15	1.00	0.24	-0.12	-0.13	-0.14	-0.17	-0.21	-0.27	-0.32	-0.15
0.06	0.08	0.11	0.14	0.18	0.24	1.00	-0.31	-0.16	-0.17	-0.21	-0.27	-0.35	-0.45	-0.55
-0.03	-0.04	-0.04	-0.06	-0.08	-0.12	-0.31	1.00	0.07	0.08	0.08	0.10	0.15	0.28	0.52
-0.36	-0.28	-0.22	-0.19	-0.16	-0.13	-0.16	0.07	1.00	0.17	0.13	0.11	0.10	0.09	0.09
-0.06	-0.30	-0.25	-0.21	-0.18	-0.14	-0.17	0.08	0.17	1.00	0.15	0.12	0.11	0.10	0.10
-0.05	-0.07	-0.29	-0.24	-0.20	-0.17	-0.21	0.08	0.13	0.15	1.00	0.14	0.13	0.12	0.12
-0.04	-0.06	-0.08	-0.29	-0.25	-0.21	-0.27	0.10	0.11	0.12	0.14	1.00	0.16	0.16	0.15
-0.04	-0.05	-0.07	-0.09	-0.30	-0.27	-0.35	0.15	0.10	0.11	0.13	0.16	1.00	0.20	0.21
-0.03	-0.05	-0.06	-0.08	-0.11	-0.32	-0.45	0.28	0.09	0.10	0.12	0.16	0.20	1.00	0.30
-0.03	-0.05	-0.06	-0.08	-0.11	-0.15	-0.55	0.52	0.09	0.10	0.12	0.15	0.21	0.30	1.00

Table 43. Parameter estimates, standard errors, and relative bias from spring spawner ADAPT-VPA using acoustic index to tune ages 4-8 and New Brunswick catch rates to tune ages 4-10.

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.000695
MEAN SQUARE RESIDUALS 0.313883

Estimates for parameters

PAR. EST.	STD. ERR.	REL. ERR.	BIAS	REL. BIAS
1.15E1	4.59E-1	0.040	1.38E-2	0.001
1.14E1	3.60E-1	0.032	1.17E-2	0.001
9.63E0	3.26E-1	0.034	1.17E-2	0.001
1.14E1	3.45E-1	0.030	9.37E-3	0.001
9.54E0	3.46E-1	0.036	1.13E-2	0.001
9.73E0	3.52E-1	0.036	1.11E-2	0.001
9.41E0	4.42E-1	0.047	3.54E-2	0.004
4.78E-1	6.05E-1	1.267	5.02E-2	0.105
-5.76E0	2.95E-1	-0.051	-1.79E-2	0.003
-6.35E0	2.86E-1	-0.045	-1.74E-2	0.003
-5.93E0	2.83E-1	-0.048	-1.80E-2	0.003
-5.66E0	2.92E-1	-0.052	-1.92E-2	0.003
-6.01E0	3.00E-1	-0.050	-2.09E-2	0.003
-6.70E0	2.08E-1	-0.031	-1.50E-2	0.002
-5.62E0	2.02E-1	-0.036	-1.45E-2	0.003
-5.43E0	2.00E-1	-0.037	-1.56E-2	0.003
-5.28E0	2.02E-1	-0.038	-1.63E-2	0.003
-5.33E0	2.05E-1	-0.038	-1.77E-2	0.003
-5.28E0	2.11E-1	-0.040	-2.10E-2	0.004
-5.08E0	2.37E-1	-0.047	-3.14E-2	0.006

Parameters in linear scale

PAR. EST.	STD. ERR.	REL. ERR.	BIAS	REL. BIAS
1.01E5	4.65E4	0.459	1.21E4	0.119
9.00E4	3.24E4	0.360	6.89E3	0.077
1.53E4	4.97E3	0.326	9.87E2	0.065
9.16E4	3.16E4	0.345	6.32E3	0.069
1.39E4	4.80E3	0.346	9.86E2	0.071
1.68E4	5.89E3	0.352	1.22E3	0.073
1.22E4	5.39E3	0.442	1.62E3	0.133
1.61E0	9.76E-1	0.605	3.76E-1	0.233
3.15E-3	9.29E-4	0.295	8.08E-5	0.026
1.75E-3	5.01E-4	0.286	4.10E-5	0.023
2.66E-3	7.53E-4	0.283	5.86E-5	0.022
3.49E-3	1.02E-3	0.292	8.17E-5	0.023
2.46E-3	7.38E-4	0.300	5.94E-5	0.024
1.23E-3	2.57E-4	0.208	8.22E-6	0.007
3.61E-3	7.30E-4	0.202	2.12E-5	0.006
4.39E-3	8.80E-4	0.200	1.98E-5	0.005
5.09E-3	1.03E-3	0.202	2.05E-5	0.004
4.85E-3	9.93E-4	0.205	1.58E-5	0.003
5.11E-3	1.08E-3	0.211	6.80E-6	0.001
6.21E-3	1.47E-3	0.237	-2.09E-5	-0.003

Table 44. Parameter correlations from ADAPT-VPA spring spawners using FRATIO method and acoustic index to tune ages 4-8 and New Brunswick catch rates to tune ages 4-10.

1.00	0.17	0.15	0.14	0.12	0.09	0.09	-0.03	-0.39	-0.11	-0.09	-0.08	-0.07	-0.31	-0.09	-0.07	-0.06	-0.05	-0.05	-0.05
0.17	1.00	0.22	0.19	0.17	0.14	0.13	-0.05	-0.33	-0.34	-0.13	-0.12	-0.11	-0.27	-0.26	-0.10	-0.09	-0.08	-0.07	-0.07
0.15	0.22	1.00	0.24	0.22	0.19	0.17	-0.06	-0.29	-0.32	-0.33	-0.16	-0.14	-0.24	-0.24	-0.25	-0.11	-0.10	-0.09	-0.09
0.14	0.19	0.24	1.00	0.27	0.24	0.24	-0.08	-0.26	-0.28	-0.31	-0.36	-0.18	-0.22	-0.22	-0.24	-0.26	-0.14	-0.13	-0.13
0.12	0.17	0.22	0.27	1.00	0.30	0.32	-0.12	-0.22	-0.25	-0.29	-0.35	-0.38	-0.20	-0.21	-0.22	-0.25	-0.28	-0.17	-0.17
0.09	0.14	0.19	0.24	0.30	1.00	0.34	-0.14	-0.14	-0.23	-0.27	-0.33	-0.37	-0.18	-0.19	-0.21	-0.24	-0.28	-0.30	-0.19
0.09	0.13	0.17	0.24	0.32	0.34	1.00	-0.32	-0.13	-0.16	-0.23	-0.35	-0.46	-0.18	-0.19	-0.22	-0.27	-0.34	-0.42	-0.52
-0.03	-0.05	-0.06	-0.08	-0.12	-0.14	-0.32	1.00	0.05	0.06	0.05	0.13	0.19	0.07	0.07	0.07	0.09	0.13	0.25	0.47
-0.39	-0.33	-0.29	-0.26	-0.22	-0.14	-0.13	0.05	1.00	0.21	0.17	0.14	0.12	0.23	0.16	0.13	0.11	0.09	0.07	0.07
-0.11	-0.34	-0.32	-0.28	-0.25	-0.23	-0.16	0.06	0.21	1.00	0.19	0.18	0.15	0.18	0.18	0.15	0.13	0.11	0.10	0.09
-0.09	-0.13	-0.33	-0.31	-0.29	-0.27	-0.23	0.05	0.17	0.19	1.00	0.21	0.19	0.15	0.16	0.17	0.15	0.14	0.13	0.11
-0.08	-0.12	-0.16	-0.36	-0.35	-0.33	-0.35	0.13	0.14	0.18	0.21	1.00	0.26	0.15	0.15	0.17	0.19	0.19	0.19	0.19
-0.07	-0.11	-0.14	-0.18	-0.38	-0.37	-0.46	0.19	0.12	0.15	0.19	0.26	1.00	0.14	0.14	0.16	0.19	0.23	0.23	0.25
-0.31	-0.27	-0.24	-0.22	-0.20	-0.18	-0.18	0.07	0.23	0.18	0.15	0.15	0.14	1.00	0.14	0.12	0.11	0.10	0.10	0.10
-0.09	-0.26	-0.24	-0.22	-0.21	-0.19	-0.19	0.07	0.16	0.18	0.16	0.15	0.14	0.14	1.00	0.12	0.11	0.11	0.10	0.10
-0.07	-0.10	-0.25	-0.24	-0.22	-0.21	-0.22	0.07	0.13	0.15	0.17	0.17	0.16	0.12	0.12	1.00	0.12	0.12	0.11	0.11
-0.06	-0.09	-0.11	-0.26	-0.25	-0.24	-0.27	0.09	0.11	0.13	0.15	0.19	0.19	0.11	0.11	0.12	1.00	0.14	0.14	0.14
-0.05	-0.08	-0.10	-0.14	-0.28	-0.28	-0.34	0.13	0.09	0.11	0.14	0.19	0.23	0.10	0.11	0.12	0.14	1.00	0.17	0.19
-0.05	-0.07	-0.09	-0.13	-0.17	-0.30	-0.42	0.25	0.07	0.10	0.13	0.19	0.23	0.10	0.10	0.11	0.14	0.17	1.00	0.26
-0.05	-0.07	-0.09	-0.13	-0.17	-0.19	-0.52	0.47	0.07	0.09	0.11	0.19	0.25	0.10	0.10	0.11	0.14	0.19	0.26	1.00

Table 45. Beginning of year population numbers, biomass, and annual fishing mortality estimated for spring spawners using ADAPT-VPA FRATIO model with catch rates alone as the calibration index. Numbers x 1000, Biomass in tonnes.

Numbers	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
2	91437	78042	58936	175084	237163	226404	277188	152533	107288	140234	170045	219636	519408	272186	160850	578948	48878	220609				
3	50530	61004	51075	38335	138763	190604	181419	225195	122813	85898	114200	134286	179465	422034	221549	130355	473328	39982	179720			
4	122131	30984	28966	20688	16875	89731	136787	142642	176586	92602	67538	88511	104744	141140	335823	176453	105934	383101	31321	143898	168096	90946
5	21219	62540	11762	6449	9344	9129	48831	98044	100625	123273	68787	46620	55797	70567	102410	242974	136846	79923	293249	22463	109729	126973
6	16971	13838	24577	2584	2487	6355	5177	32006	66448	68097	76826	43155	31794	34531	43223	71163	161818	83052	51263	188967	13744	74620
7	14711	7845	7500	6864	426	1587	4787	3881	21066	41708	42174	44496	27747	21906	19339	26905	40518	82758	48135	31129	116769	8842
8	5140	6219	3725	1420	2419	61	1193	3867	1957	13961	23539	23641	26342	19304	14190	12351	15104	23255	39021	24880	18076	66561
9	3086	2807	3348	648	386	1660	18	919	2540	764	7038	10840	13734	15467	11709	9749	7024	6712	13050	21532	14942	11103
10	4673	950	1806	651	129	146	1358	11	596	1876	169	2845	5250	7972	8091	7481	5080	4098	3250	7366	13579	9633
11	11960	5233	2078	1575	731	114	212	1280	924	903	1798	555	1323	3706	5879	7651	6470	5904	3478	2382	6104	12667
4+	200092	130416	83760	41078	32796	108784	196362	282650	370742	343184	285869	260663	266732	314593	540464	554728	476793	668802	482767	442617	459040	401345
5+	77961	99432	54794	20390	15921	19053	61576	140009	194156	250582	218331	172152	161988	173453	204841	378275	372860	285702	451446	298719	292944	310399
7+	39772	23055	18455	11357	4090	3569	7588	9958	27083	59212	74718	82377	74397	68355	59206	84137	74196	122727	106934	87289	169471	108806

Biomass	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
2	8846	8151	6188	19686	25572	24555	30109	16663	10328	14623	15118	24367	57640	27469	14653	52763	4995	17613				
3	7942	6665	8074	6570	24664	31172	31949	40186	20574	13087	18018	18879	31663	69644	32282	16478	62507	5491	21261			
4	22364	5414	5149	4073	3428	17390	24830	29028	35214	17111	13042	18338	19994	25779	55882	27561	15820	60794	4751	23785	25140	14198
5	4827	14080	2482	1588	2359	2128	10469	21863	23531	26875	15113	10279	12279	14899	20005	43882	23873	13900	51002	4043	19763	22601
6	4422	3401	6230	730	763	1709	1349	7957	17088	17734	19531	11185	7995	8247	9894	14827	31417	16126	9945	36361	2881	14464
7	4160	2221	1978	2069	149	502	1363	1188	6329	11541	12126	12936	7612	5820	4840	6484	8824	17715	10175	6454	24856	1861
8	1546	1935	1099	420	861	18	407	1295	651	4330	7212	7258	7908	5451	3762	3239	3775	6509	9069	5621	4111	16215
9	1024	917	1112	218	132	554	6	403	846	235	2322	3561	4301	4638	3420	2811	1979	1800	3197	5322	3705	2739
10	1669	299	650	301	50	55	520	4	242	559	56	1003	1744	2495	2466	2220	1554	1236	928	1818	3589	2558
11	4351	1892	709	612	292	45	83	460	334	328	607	188	445	1224	1868	2357	2009	1818	1075	740	1733	3816
4+	44364	30158	19409	10011	8035	22401	39027	62199	84234	78712	70009	62727	62276	68553	102137	103381	89251	118897	90144	84144	85577	77452
5+	21999	24744	14260	5939	4607	5011	14197	33171	49020	61601	56967	46389	42282	42774	46255	75820	73430	58103	85392	60359	60437	63254
7+	12750	7263	5548	3621	1485	1174	2379	3351	8401	16992	22323	24945	22009	19627	16356	17111	18141	28078	24445	19956	37993	26189

F	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
2	0.205	0.224	0.23	0.032	0.019	0.022	0.008	0.017	0.025	0.005	0.036	0.002	0.008	0.006	0.01	0.001	0.001	0.005	0.001	0.006	0.006
3	0.289	0.545	0.704	0.621	0.236	0.132	0.04	0.043	0.082	0.038	0.055	0.048	0.04	0.029	0.028	0.007	0.011	0.044	0.022	0.009	0.034
4	0.469	0.769	1.302	0.595	0.414	0.408	0.133	0.149	0.159	0.127	0.171	0.261	0.195	0.121	0.123	0.054	0.082	0.067	0.132	0.071	0.069
5	0.227	0.734	1.316	0.753	0.185	0.367	0.222	0.189	0.19	0.273	0.237	0.183	0.28	0.29	0.164	0.206	0.299	0.244	0.239	0.291	0.186
6	0.572	0.412	1.076	1.604	0.249	0.083	0.088	0.218	0.266	0.279	0.346	0.242	0.173	0.38	0.274	0.363	0.471	0.345	0.299	0.281	0.241
7	0.661	0.545	1.465	0.843	1.743	0.065	0.013	0.465	0.211	0.372	0.379	0.324	0.163	0.234	0.248	0.377	0.355	0.552	0.46	0.344	0.362
8	0.405	0.42	1.549	1.103	0.177	1.023	0.061	0.22	0.74	0.485	0.575	0.343	0.332	0.3	0.175	0.364	0.611	0.378	0.395	0.31	0.287
9	0.979	0.241	1.169	1.416	0.769	0.001	0.281	0.233	0.103	1.306	0.706	0.525	0.344	0.448	0.248	0.452	0.339	0.525	0.372	0.261	0.239
10	0.809	0.719	0.612	0.848	1.471	0.008	0.004	0.104	0.274	0.216	0.847	0.712	0.353	0.447	0.36	0.57	0.407	0.737	0.734	0.251	0.222
11+	1.039	0.924	0.787	1.089	1.869	0.01	0.005	0.134	0.352	0.277	1.068	0.915	0.454	0.574	0.462	0.732	0.523	0.946	0.943	0.322	0.285
ave 5-9	0.57	0.47	1.32	1.14	0.62	0.31	0.13	0.27	0.30	0.54	0.45	0.32	0.26	0.33	0.22	0.35	0.42	0.41	0.35	0.30	0.26
wt 4+	0.47	0.67	1.26	0.77	0.34	0.37	0.15	0.18	0.19	0.26	0.31	0.27	0.23	0.23	0.15	0.19	0.32	0.20	0.28	0.22	0.20
Ave 5-9 ER	0.40	0.34	.068	0.63	0.43	0.24	0.11	0.21	0.24	0.38	0.33	0.25	0.21	0.26	0.18	0.27	0.31	0.31	0.27	0.23	0.21
Wt 4+ ER	0.34	0.45	0.66	0.49	0.26	0.29	0.13	0.15	0.16	0.21	0.24	0.22	0.19	0.18	0.13	0.16	0.25	0.16	0.22	0.18	0.16

Table 46. Sum of fishing mortalities along cohorts to determine which add up to 2 or more. Numbers under year refer to sum of cohort starting with age two. For example, 1978 = 3.98 which is the sum of age 2 in 1978, age 3 in 1979, and continuing to 11+.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	0.21	0.22	0.23	0.03	0.02	0.02	0.01	0.02	0.03	0.01	0.04	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.01
3	0.29	0.55	0.70	0.62	0.24	0.13	0.04	0.04	0.08	0.04	0.06	0.05	0.04	0.03	0.03	0.01	0.01	0.04	0.02	0.01	0.03
4	0.47	0.77	1.30	0.60	0.41	0.41	0.13	0.15	0.16	0.13	0.17	0.26	0.20	0.12	0.12	0.05	0.08	0.07	0.13	0.07	0.07
5	0.23	0.73	1.32	0.75	0.19	0.37	0.22	0.19	0.19	0.27	0.24	0.18	0.28	0.29	0.16	0.21	0.30	0.24	0.24	0.29	0.19
6	0.57	0.41	1.08	1.60	0.25	0.08	0.09	0.22	0.27	0.28	0.35	0.24	0.17	0.38	0.27	0.36	0.47	0.35	0.30	0.28	0.24
7	0.66	0.55	1.47	0.84	1.74	0.09	0.01	0.49	0.21	0.37	0.38	0.32	0.16	0.23	0.25	0.38	0.36	0.55	0.46	0.34	0.36
8	0.41	0.42	1.55	1.10	0.18	1.02	0.06	0.22	0.74	0.49	0.58	0.34	0.33	0.30	0.18	0.36	0.61	0.38	0.40	0.31	0.29
9	0.98	0.24	1.17	1.42	0.77	0.00	0.28	0.23	0.10	1.31	0.71	0.53	0.34	0.45	0.25	0.45	0.34	0.53	0.37	0.26	0.24
10	0.81	0.72	0.61	0.85	1.47	0.01	0.00	0.10	0.27	0.22	0.85	0.71	0.35	0.45	0.36	0.57	0.41	0.74	0.73	0.25	0.22
11	1.04	0.92	0.79	1.09	1.89	0.01	0.01	0.13	0.35	0.28	1.09	0.92	0.45	0.57	0.46	0.73	0.52	0.95	0.94	0.32	0.29
Sum	3.98	3.43	6.01	3.68	3.14	2.66	3.03	2.51	2.80	3.61	3.41	2.33	2.27	1.74	1.27	0.96	0.71	0.28	0.08	0.04	0.01

Table 47. Beginning of year population numbers, biomass, and annual fishing mortality estimates for spring spawners using ADAPT-VPA FRATIO model with acoustic and catch rate indices for calibration.

Numbers

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	91458	78068	58931	175389	237727	226839	277255	152338	106934	139813	169404	216296	509801	301608	168057	641207	63649	239582	181711			
3	50530	61022	51096	38331	139013	191066	181776	225251	122653	85409	113855	133741	176730	414168	245638	136256	524301	52076	195254	148526		
4	122270	30984	26960	20705	16872	89935	137165	142934	176631	92472	67301	88229	104315	138901	329183	196175	110765	424834	41223	156616	120094	90946
5	21241	82653	11762	6461	9358	9127	46998	98354	100864	123310	66680	46426	55566	70215	100577	237703	152992	83878	327416	30568	120140	89314
6	16972	13856	24669	2584	2496	6366	5175	32143	66702	68292	76856	43067	31636	34343	42936	69664	157506	96254	54498	216917	20373	83140
7	14697	7846	7515	6937	425	1595	4797	3860	21178	41915	42334	44521	27675	21776	19185	26870	39293	79240	58926	33774	139627	14266
8	5121	6208	3726	1431	2479	61	1199	3875	1956	14052	23708	23772	26363	19245	14063	12225	14912	22254	36156	33691	20238	85242
9	3072	2791	3337	649	395	1709	18	924	2546	763	7113	10978	13841	15484	11662	9663	6921	6555	12233	19193	22148	12871
10	4811	938	1793	843	129	154	1368	11	600	1881	169	2905	8362	8060	8104	7442	5009	4014	3123	6699	11686	15528
11	12097	5296	2119	1598	744	125	226	1325	961	936	1829	580	1393	3855	6072	7820	6577	5934	3435	2245	5447	10565
4+	200281	130572	83900	41208	32898	109071	198975	283444	371437	343622	285990	260478	266150	311878	531802	587361	493974	722964	537009	499702	459734	401872
5+	78011	99588	54920	20503	16026	19136	61811	140510	194806	251150	218688	172249	161835	172977	202619	371186	383209	298130	495786	343086	339640	310926
7+	39798	23079	18489	11459	4173	3643	7838	10014	27240	59548	75153	82755	74634	68419	59107	63819	72712	117998	113873	95602	199126	138472

Biomass

Age	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
2	8848	8154	6187	19722	25633	24802	30116	16841	10294	14579	15061	23996	56574	30438	15309	58437	6504	19127				16427
3	7942	8667	8077	6569	24709	31248	32011	40198	20548	13043	17963	18805	31181	68346	35792	17223	69239	7152	23099			16719
4	22390	5414	5152	4076	3428	17430	24899	29087	35223	17087	12997	16286	19912	25370	54810	30641	16542	67417	6253	25887	18177	14198
5	4832	14106	2482	1591	2363	2127	10505	21932	23587	26883	15088	10236	12228	14825	19647	42930	26689	14588	56945	5501	21638	22601
6	4423	3405	6253	730	766	1712	1349	7990	17153	17785	19539	11142	7955	8202	9828	14514	30579	18689	10573	41739	3974	14464
7	4156	2222	1982	2092	149	505	1365	1188	6362	11599	12172	12943	7592	5785	4802	6427	8557	16962	12456	7003	29721	1861
8	1540	1932	1099	424	882	18	409	1298	650	4358	7264	7298	7914	5434	3733	3206	3727	5272	8403	7611	4603	15215
9	1019	911	1109	218	136	570	6	406	848	234	2346	3607	4334	4643	3406	2786	1950	1758	2997	4744	5492	2739
10	1648	295	646	298	51	57	535	4	244	560	56	1024	1781	2522	2470	2209	1533	1211	892	1653	3063	2558
11	4400	1914	722	621	297	49	89	476	347	340	617	196	468	1273	1930	2409	2042	1827	1062	696	1546	3816
4+	44406	30198	19445	10050	8071	22469	39157	62361	84414	78846	70060	62732	62164	68055	100626	105122	91619	127723	99581	94836	88234	77452
5+	22018	24784	14294	5974	4643	5039	14258	33294	49192	61759	57083	46446	42272	42885	45816	74481	75077	60306	93328	68949	70067	63254
7+	12764	7274	5558	3653	1514	1200	2405	3371	8451	17091	22456	25067	22089	19658	16341	17037	17809	27030	25810	21709	44444	26189

F

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	0.20	0.22	0.23	0.03	0.02	0.02	0.01	0.02	0.02	0.01	0.04	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01
3	0.29	0.54	0.70	0.62	0.24	0.13	0.04	0.04	0.08	0.04	0.05	0.05	0.04	0.03	0.02	0.01	0.01	0.03	0.02	0.01	0.03
4	0.47	0.77	1.30	0.59	0.41	0.41	0.13	0.15	0.16	0.13	0.17	0.26	0.20	0.12	0.13	0.05	0.08	0.06	0.10	0.07	0.10
5	0.23	0.73	1.32	0.75	0.19	0.37	0.22	0.19	0.19	0.27	0.24	0.18	0.28	0.29	0.17	0.21	0.26	0.23	0.21	0.21	0.17
6	0.57	0.41	1.07	1.60	0.25	0.08	0.09	0.22	0.26	0.28	0.35	0.24	0.17	0.38	0.28	0.37	0.49	0.29	0.26	0.24	0.16
7	0.66	0.54	1.46	0.83	1.74	0.09	0.01	0.48	0.21	0.37	0.38	0.32	0.16	0.24	0.25	0.38	0.37	0.58	0.36	0.31	0.29
8	0.41	0.42	1.55	1.09	0.17	1.02	0.06	0.22	0.74	0.48	0.57	0.34	0.33	0.30	0.18	0.37	0.62	0.40	0.43	0.22	0.25
9	0.99	0.24	1.18	1.41	0.74	0.00	0.28	0.23	0.10	1.31	0.70	0.52	0.34	0.45	0.25	0.46	0.34	0.54	0.40	0.30	0.16
10	0.82	0.73	0.62	0.86	1.46	0.01	0.00	0.10	0.27	0.22	0.85	0.59	0.34	0.44	0.36	0.57	0.41	0.76	0.78	0.28	0.26
11	1.02	0.91	0.76	1.06	1.80	0.01	0.00	0.13	0.34	0.27	1.06	0.85	0.43	0.55	0.44	0.71	0.51	0.94	0.96	0.35	0.32
ave 5-9	0.57	0.47	1.31	1.14	0.62	0.31	0.13	0.27	0.30	0.54	0.45	0.32	0.26	0.33	0.22	0.36	0.42	0.41	0.34	0.26	0.21
wt 4+	0.47	0.67	1.25	0.76	0.34	0.37	0.15	0.18	0.19	0.26	0.31	0.27	0.23	0.23	0.15	0.19	0.31	0.18	0.25	0.19	0.19
Ave 5-9 ER	0.40	0.34	0.68	0.63	0.42	0.24	0.11	0.21	0.24	0.38	0.33	0.25	0.21	0.26	0.18	0.27	0.31	0.31	0.26	0.20	0.17
Wt 4+ ER	0.34	0.45	0.66	0.49	0.26	0.28	0.13	0.15	0.16	0.21	0.24	0.22	0.19	0.19	0.13	0.16	0.25	0.15	0.20	0.16	0.16

Table 48. Spring spawner projections using results from ADAPT-VPA with catch rates as calibration index.

	Weights			Numbers			Biomass			Projections Catch (t) F – Fully Recruited	
										0.44	0.44
Age	Beginning	Catch	Ave PR	1998	1999	2000	1998	1999	2000	1999	2000
2	0.0954	0.1276	0.01	172229	172229	172229	16427	16427	16427	123	123
3	0.1308	0.1457	0.06	127865	127865	140137	16719	16719	18324	423	464
4	0.1561	0.1711	0.22	166096	90946	102065	25140	14198	15934	1280	1436
5	0.1780	0.1834	0.65	109729	126973	67714	19763	22601	12053	5264	2807
6	0.1938	0.2048	0.72	13744	74620	78153	2681	14464	15149	3795	3975
7	0.2105	0.2164	1	116769	8842	44439	24856	1861	9356	622	3126
8	0.2286	0.2395	0.85	18076	66561	4662	4111	15215	1066	4533	317
9	0.2467	0.2522	0.73	14942	11103	37504	3705	2739	9252	700	2365
10	0.2656	0.2717	0.85	13579	9633	6596	3589	2558	1752	747	511
11	0.3012	0.3208	0.85	6104	12667	12546	1733	3816	3779	1159	1148
2+				759134	701439	666045	118723	110598	103092	18646	16272
4+				459040	401345	353679	85577	77452	68341	18100	15685

Table 49. Fall Spawner multiplicative analysis results.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	31	3665.49999	118.24194	150.101	0.0001
Error	3183	2507.40326	0.78775		
C Total	3214	6172.90324			

Root MSE	0.88755	R-square	0.5938
Dep Mean	5.89634	Adj R-sq	0.5898
C.V.	15.05260		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	7.207942	0.08213787	87.754	0.0001
YY78	1	-1.119388	0.14239979	-7.861	0.0001
YY79	1	-1.878909	0.11107199	-16.916	0.0001
YY80	1	-1.973132	0.10911079	-18.084	0.0001
YY81	1	-1.316857	0.09147782	-14.395	0.0001
YY82	1	-1.314173	0.09322945	-14.096	0.0001
YY83	1	-0.931754	0.09278774	-10.042	0.0001
YY84	1	-0.409107	0.09704121	-4.216	0.0001
YY85	1	0.283325	0.10048403	2.822	0.0432
YY86	1	-0.163625	0.10200408	-1.604	0.1088
YY88	1	-0.165646	0.10228778	-1.619	0.1055
YY89	1	0.244500	0.10722860	2.280	0.0227
YY90	1	0.241038	0.09751348	2.492	0.0127
YY91	1	0.358345	0.10488892	3.416	0.0006
YY92	1	0.315899	0.10004737	3.157	0.0016
YY93	1	0.219805	0.10288787	2.136	0.0327
YY94	1	0.274573	0.09062481	3.030	0.0025
YY95	1	0.042081	0.09219492	0.456	0.6481
YY96	1	-0.064682	0.10523596	-0.615	0.5388
YY97	1	0.182488	0.11061852	1.650	0.0991
YY98	1	0.150165	0.10688016	1.405	0.1601
D11	1	-0.835927	0.05513475	-15.162	0.0001
D13	1	-1.163133	0.08723457	-13.333	0.0001
D65	1	-1.066932	0.05023554	-21.239	0.0001
D67	1	-0.191327	0.05622255	-3.403	0.0007
D87	1	-0.501045	0.05532449	-9.056	0.0001
D92	1	-1.051245	0.06077685	-17.297	0.0001
W1	1	-1.205122	0.05349332	-22.528	0.0001
W2	1	-0.299292	0.05305562	-5.641	0.0001
W3	1	-0.121398	0.04887710	-2.484	0.0131
W5	1	-0.050557	0.05374523	-0.941	0.3469
W6	1	-0.518273	0.07197790	-7.089	0.0001

Table 50. Fall spawner catch rates, split into two time periods according to change in mesh, used to calibrate ADAPT-VPA model. Number (x 1000)/net/trip/day. The 0.75 portion of the year indicates the month of the year to which the index refers in decimal format.

a) CUE index

CUE_1	4	5	6	7	8	9	10
1978.75	637	400	94	86	449	13	18
1979.75	463	238	136	40	49	41	13
1980.75	231	269	44	77	16	10	13
1981.75	1175	307	121	50	29	13	12
1982.75	630	710	207	106	44	16	5
1983.75	1152	545	751	123	93	28	7
1984.75	2080	1124	694	500	112	38	17
1985.75	1045	2896	1761	1126	533	144	86
1986.75	1503	754	1574	880	375	213	16
1987.75	1506	1192	816	1432	612	370	180
1988.75	881	1809	873	571	615	300	118
1989.75	1075	1680	2261	1071	543	687	253
1990.75	1020	896	1276	2451	769	414	450
1991.75	4145	1075	768	1133	1397	508	253

CUE_2	4	5	6	7	8	9	10
1992.75	1066	4492	1009	608	740	773	377
1993.75	266	3241	3981	658	346	399	213
1994.75	451	604	2385	3439	602	476	475
1995.75	148	1622	616	2011	1790	340	240
1996.75	819	815	1869	417	981	1009	218
1997.75	1209	4389	893	1377	259	472	436
1998.75	1372	1937	2785	681	985	183	352

b) Acoustic Index, Numbers x 100,000 to scale them to same level as CUE indices.

Acoustic	4	5	6	7	8	9
1994.8	3338	1052	1020	1045	133	71
1995.8	129	914	172	362	351	46
1996.8	2139	360	1141	231	88	144
1997.8	1755	753	154	405	183	134
1998.8	401	339	139	47	143	29

Table 51. Fall spawner multiplicative model results with area by week interaciton.

General Linear Models Procedure

Dependent Variable: CPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	61	3908.53807572	64.07439468	89.22	0.0001
Error	3153	2264.36516917	0.71816212		
Corrected Total	3214	6172.90324489			

R-Square	C.V.	Root MSE	CPUE Mean
0.633177	14.37239	0.84744447	5.89633615

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YC	20	1176.94166461	58.84708323	81.94	0.0001
SDC	6	519.26353984	86.54392331	120.51	0.0001
WC	5	449.87151703	89.97430341	125.28	0.0001
WC*SDC	30	243.03809064	8.10126969	11.28	0.0001

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		6.994771642 B	68.41	0.0001	0.10224613
YC	78	-1.131319922 B	-8.20	0.0001	0.13794306
	79	-1.673950755 B	-15.25	0.0001	0.10977516
	80	-1.873347782 B	-17.59	0.0001	0.10652042
	81	-1.207449147 B	-13.67	0.0001	0.08830818
	82	-1.251580582 B	-13.87	0.0001	0.09022774
	83	-0.928730794 B	-10.30	0.0001	0.09014723
YC	84	-0.314205806 B	-3.37	0.0008	0.09324287
	85	0.253463940 B	2.63	0.0087	0.09647945
	86	-0.088268295 B	-0.90	0.3686	0.09816161
	88	-0.086513360 B	-0.87	0.3837	0.09929598
	89	0.306992078 B	2.98	0.0029	0.10311028
	90	0.290639686 B	3.11	0.0019	0.09354694
	91	0.428195561 B	4.26	0.0001	0.10059940
	92	0.370986100 B	3.85	0.0001	0.09633489

	93	0.279966562 B	2.82	0.0048	0.09918915
	94	0.371034774 B	4.25	0.0001	0.08728624
	95	0.146750087 B	1.65	0.0988	0.08887111
	96	0.060186162 B	0.60	0.5516	0.10107130
	97	0.222452000 B	2.10	0.0360	0.10604927
	98	0.166004848 B	1.62	0.1053	0.10245842
	870	0.000000000 B	.	.	.
SDC	11	-0.845451794 B	-7.74	0.0001	0.10916274
	13	-0.853604885 B	-5.10	0.0001	0.16722400
	65	-0.828189272 B	-7.66	0.0001	0.10811619
	67	0.022043828 B	0.19	0.8513	0.11759435
	87	-0.501145367 B	-4.17	0.0001	0.12014537
	92	-0.603584737 B	-4.97	0.0001	0.12150229
	660	0.000000000 B	.	.	.
WC	1	-0.669148030 B	-5.43	0.0001	0.12330215
	2	-0.149990718 B	-1.36	0.1754	0.11066533
	3	0.033323669 B	0.31	0.7553	0.10689179
	5	-0.114531411 B	-0.92	0.3588	0.12480285
	6	-0.459494845 B	-3.11	0.0019	0.14790278
	40	0.000000000 B	.	.	.

Table 52. Fall spawner ADAPT-VPA results using single CUE index to calibrate model.

orthogonality offset 0.00697

mean square residuals 0.20017

	par est	std err	cv	t-stat	% bias
4	329898.785	153815.933	0.466252	2.144763	10.945353
5	220516.821	78398.3663	0.355521	2.812773	6.019023
6	221938.195	71988.4962	0.324363	3.082968	4.627368
7	38409.9007	12313.1100	0.320571	3.119431	4.166245
8	57920.5194	18525.0221	0.319835	3.126610	3.964941
9	12718.1669	3926.11446	0.308701	3.239378	3.673233
10	29496.0192	8704.47300	0.295107	3.388605	3.331420
4	0.003888	0.000399	0.102671	9.739807	0.329912
5	0.007654	0.000772	0.100892	9.911590	0.376307
6	0.008957	0.000899	0.100334	9.966679	0.426236
7	0.011051	0.001107	0.100158	9.984255	0.483300
8	0.012141	0.001213	0.099915	10.008538	0.530935
9	0.011735	0.001166	0.099334	10.067004	0.543186
10	0.012792	0.001261	0.098557	10.146371	0.527600

parameter correltion matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.00	0.04	0.03	0.02	0.02	0.01	0.01	-0.22	-0.01	-0.01	-0.01	-0.00	-0.00	-0.00
2	0.04	1.00	0.04	0.03	0.02	0.02	0.01	-0.16	-0.17	-0.01	-0.01	-0.01	-0.00	-0.00
3	0.03	0.04	1.00	0.04	0.03	0.02	0.02	-0.12	-0.14	-0.16	-0.01	-0.01	-0.01	-0.00
4	0.02	0.03	0.04	1.00	0.04	0.03	0.03	-0.09	-0.11	-0.13	-0.15	-0.01	-0.01	-0.00
5	0.02	0.02	0.03	0.04	1.00	0.04	0.03	-0.07	-0.08	-0.10	-0.12	-0.15	-0.01	-0.00
6	0.01	0.02	0.02	0.03	0.04	1.00	0.04	-0.05	-0.06	-0.07	-0.10	-0.12	-0.15	-0.01
7	0.01	0.01	0.02	0.03	0.03	0.04	1.00	-0.04	-0.05	-0.06	-0.08	-0.10	-0.12	-0.14
8	-0.22	-0.16	-0.12	-0.09	-0.07	-0.05	-0.04	1.00	0.06	0.04	0.03	0.02	0.01	0.01
9	-0.01	-0.17	-0.14	-0.11	-0.08	-0.06	-0.05	0.06	1.00	0.04	0.03	0.02	0.01	0.01
10	-0.01	-0.01	-0.16	-0.13	-0.10	-0.07	-0.06	0.04	0.04	1.00	0.04	0.03	0.02	0.01
11	-0.01	-0.01	-0.01	-0.15	-0.12	-0.10	-0.08	0.03	0.03	0.04	1.00	0.04	0.02	0.01
12	-0.00	-0.01	-0.01	-0.01	-0.15	-0.12	-0.10	0.02	0.02	0.03	0.04	1.00	0.03	0.01
13	-0.00	-0.00	-0.01	-0.01	-0.01	-0.15	-0.12	0.01	0.01	0.02	0.02	0.03	1.00	0.02
14	-0.00	-0.00	-0.00	-0.00	-0.00	-0.01	-0.14	0.01	0.01	0.01	0.01	0.01	0.02	1.00

Table 53. Fall spawner ADAPT-VPA results using split cue indices, F-OLD model.

orthogonality offset 0.0034

mean square residuals 0.15358

	par est	std err	cv	t-stat	% bias
4	756724.655	330940.857	0.437333	2.286588	10.420605
5	327208.884	108489.953	0.331562	3.016029	5.995344
6	253068.451	77638.4343	0.306788	3.259577	4.793962
7	37877.7145	11773.2898	0.310824	3.217258	4.456474
8	53703.7577	16883.7588	0.314387	3.180794	4.242432
9	10746.7081	3312.41479	0.308226	3.244373	3.921310
10	24400.8629	7164.39054	0.293612	3.405853	3.458663
4	0.005418	0.000570	0.105262	9.500121	0.558557
5	0.007281	0.000766	0.105262	9.500121	0.558557
6	0.007883	0.000830	0.105262	9.500121	0.558557
7	0.010027	0.001055	0.105262	9.500121	0.558557
8	0.011673	0.001229	0.105262	9.500121	0.558557
9	0.010616	0.001117	0.105262	9.500121	0.558557
10	0.012070	0.001270	0.105262	9.500121	0.558557
4	0.001709	0.000313	0.182971	5.465343	0.847813
5	0.008038	0.001378	0.171493	5.831138	0.854002
6	0.011647	0.001950	0.167391	5.97[illegible]38	0.979437
7	0.013912	0.002307	0.165805	6.0[illegible]34	1.159437
8	0.013742	0.002248	0.163588	6.11[illegible]34	1.314735
9	0.014983	0.002387	0.159326	6.27[illegible]437	1.356687
10	0.014745	0.002273	0.154134	6.487851	1.294718

parameter correltion matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	1.00	0.15	0.13	0.11	0.09	0.07	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.42	-0.10	-0.08	-0.06	-0.05	-0.03	-0.02
2	0.15	1.00	0.17	0.15	0.12	0.10	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.35	-0.35	-0.11	-0.08	-0.06	-0.04	-0.02
3	0.13	0.17	1.00	0.18	0.15	0.12	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.30	-0.31	-0.33	-0.10	-0.08	-0.05	-0.03
4	0.11	0.15	0.18	1.00	0.18	0.15	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.25	-0.27	-0.29	-0.32	-0.10	-0.06	-0.03
5	0.09	0.12	0.15	0.18	1.00	0.18	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.21	-0.22	-0.25	-0.28	-0.32	-0.08	-0.04
6	0.07	0.10	0.12	0.15	0.18	1.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.17	-0.17	-0.20	-0.24	-0.27	-0.30	-0.04
7	0.06	0.08	0.10	0.12	0.15	0.17	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.14	-0.14	-0.16	-0.19	-0.23	-0.25	-0.26
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	-0.42	-0.35	-0.30	-0.25	-0.21	-0.17	-0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.24	0.18	0.14	0.11	0.07	0.04
16	-0.10	-0.35	-0.31	-0.27	-0.22	-0.17	-0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	1.00	0.19	0.15	0.11	0.07	0.04
17	-0.08	-0.11	-0.33	-0.29	-0.25	-0.20	-0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.19	1.00	0.17	0.13	0.08	0.04
18	-0.06	-0.08	-0.10	-0.32	-0.28	-0.24	-0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.15	0.17	1.00	0.15	0.10	0.05
19	-0.05	-0.06	-0.08	-0.10	-0.32	-0.27	-0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11	0.13	0.15	1.00	0.12	0.06
20	-0.03	-0.04	-0.05	-0.06	-0.08	-0.30	-0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.08	0.10	0.12	1.00	0.08
21	-0.02	-0.02	-0.03	-0.03	-0.04	-0.04	-0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.05	0.06	0.06	1.00

Table 54. Fall spawner ADAPT-VPA results using split CUE FRATIO model.

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.001654
MEAN SQUARE RESIDUALS 0.148121

Estimates for parameters

PAR. EST.	STD. ERR.	REL. ERR.	BIAS	REL. BIAS
1.36E1	4.30E-1	0.032	1.18E-2	0.001
1.27E1	3.29E-1	0.026	9.42E-3	0.001
1.25E1	3.08E-1	0.025	6.68E-3	0.001
1.06E1	3.17E-1	0.030	3.64E-3	0.000
1.09E1	3.29E-1	0.030	1.64E-3	0.000
9.31E0	3.33E-1	0.036	8.44E-4	0.000
1.11E1	3.34E-1	0.030	-3.63E-3	0.000
2.07E-1	1.05E-1	0.509	5.50E-3	0.027
-5.19E0	1.05E-1	-0.020	-2.54E-3	0.000
-4.88E0	1.06E-1	-0.022	-2.51E-3	0.001
-4.79E0	1.07E-1	-0.022	-2.52E-3	0.001
-4.53E0	1.09E-1	-0.024	-2.69E-3	0.001
-4.35E0	1.13E-1	-0.026	-2.92E-3	0.001
-4.41E0	1.22E-1	-0.028	-3.48E-3	0.001
-4.27E0	1.28E-1	-0.030	-4.09E-3	0.001
-6.39E0	1.85E-1	-0.029	-1.24E-2	0.002
-4.84E0	1.77E-1	-0.037	-1.12E-2	0.002
-4.47E0	1.77E-1	-0.040	-1.04E-2	0.002
-4.29E0	1.83E-1	-0.043	-9.64E-3	0.002
-4.31E0	1.91E-1	-0.044	-8.65E-3	0.002
-4.22E0	1.99E-1	-0.047	-7.75E-3	0.002
-4.23E0	2.09E-1	-0.049	-7.33E-3	0.002

Parameters in linear scale

PAR. EST.	STD. ERR.	REL. ERR.	BIAS	REL. BIAS
7.69E5	3.31E5	0.430	8.03E4	0.104
3.32E5	1.09E5	0.329	2.11E4	0.064
2.57E5	7.90E4	0.308	1.39E4	0.054
3.85E4	1.22E4	0.317	2.07E3	0.054
5.48E4	1.80E4	0.329	3.05E3	0.056
1.10E4	3.67E3	0.333	6.20E2	0.056
6.50E4	2.17E4	0.334	3.39E3	0.052
1.23E0	1.29E-1	0.105	1.36E-2	0.011
5.59E-3	5.87E-4	0.105	1.67E-5	0.003
7.59E-3	8.00E-4	0.106	2.32E-5	0.003
8.32E-3	8.86E-4	0.107	2.62E-5	0.003
1.08E-2	1.17E-3	0.109	3.48E-5	0.003
1.29E-2	1.45E-3	0.113	4.47E-5	0.003
1.21E-2	1.47E-3	0.122	4.76E-5	0.004
1.40E-2	1.79E-3	0.128	5.71E-5	0.004
1.68E-3	3.12E-4	0.185	7.91E-6	0.005
7.93E-3	1.40E-3	0.177	3.47E-5	0.004
1.15E-2	2.04E-3	0.177	6.06E-5	0.005
1.37E-2	2.50E-3	0.183	9.75E-5	0.007
1.34E-2	2.56E-3	0.191	1.29E-4	0.010
1.47E-2	2.91E-3	0.199	1.76E-4	0.012
1.45E-2	3.03E-3	0.209	2.10E-4	0.014

Table 55. Fall spawner parameter correlations from ADAPT-VPA using split CUE FRATIO model.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	1	0.16	0.15	0.13	0.12	0.11	0.12	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.43	-0.13	-0.11	-0.11	-0.1	-0.09	-0.09
2	0.16	1	0.21	0.19	0.17	0.16	0.18	-0.03	-0.03	-0.03	-0.02	-0.02	-0.02	-0.03	-0.03	-0.38	-0.38	-0.16	-0.15	-0.14	-0.14	-0.13
3	0.15	0.21	1	0.24	0.22	0.21	0.24	-0.05	-0.04	-0.03	-0.03	-0.03	-0.03	-0.04	-0.04	-0.34	-0.36	-0.38	-0.2	-0.19	-0.18	-0.17
4	0.13	0.19	0.24	1	0.27	0.26	0.31	-0.06	-0.05	-0.04	-0.04	-0.04	-0.04	-0.05	-0.05	-0.31	-0.34	-0.37	-0.41	-0.24	-0.23	-0.22
5	0.12	0.17	0.22	0.27	1	0.31	0.38	-0.08	-0.06	-0.05	-0.05	-0.05	-0.06	-0.06	-0.07	-0.28	-0.31	-0.36	-0.4	-0.44	-0.28	-0.27
6	0.11	0.16	0.21	0.26	0.31	1	0.46	-0.1	-0.07	-0.07	-0.06	-0.06	-0.07	-0.08	-0.08	-0.26	-0.29	-0.33	-0.39	-0.44	-0.48	-0.33
7	0.12	0.18	0.24	0.31	0.38	0.46	1	-0.26	-0.16	-0.15	-0.15	-0.15	-0.17	-0.19	-0.2	-0.28	-0.34	-0.41	-0.49	-0.58	-0.65	-0.72
8	-0.02	-0.03	-0.05	-0.06	-0.08	-0.1	-0.26	1	0.16	0.2	0.25	0.32	0.41	0.53	0.59	0.05	0.06	0.08	0.1	0.13	0.16	0.2
9	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07	-0.16	0.16	1	0.04	0.05	0.06	0.07	0.09	0.1	0.04	0.05	0.06	0.08	0.09	0.1	0.12
10	-0.02	-0.03	-0.03	-0.04	-0.05	-0.07	-0.15	0.2	0.04	1	0.06	0.07	0.09	0.11	0.12	0.04	0.05	0.06	0.07	0.08	0.1	0.11
11	-0.02	-0.02	-0.03	-0.04	-0.05	-0.06	-0.15	0.25	0.05	0.06	1	0.08	0.11	0.14	0.15	0.04	0.04	0.05	0.07	0.08	0.09	0.11
12	-0.02	-0.02	-0.03	-0.04	-0.05	-0.06	-0.15	0.32	0.06	0.07	0.08	1	0.14	0.17	0.19	0.04	0.04	0.06	0.07	0.08	0.1	0.11
13	-0.02	-0.02	-0.03	-0.04	-0.06	-0.07	-0.17	0.41	0.07	0.09	0.11	0.14	1	0.22	0.25	0.04	0.05	0.06	0.07	0.09	0.1	0.13
14	-0.02	-0.03	-0.04	-0.05	-0.06	-0.08	-0.19	0.53	0.09	0.11	0.14	0.17	0.22	1	0.32	0.04	0.05	0.07	0.08	0.1	0.12	0.15
15	-0.02	-0.03	-0.04	-0.05	-0.07	-0.08	-0.2	0.59	0.1	0.12	0.15	0.19	0.25	0.32	1	0.04	0.05	0.07	0.09	0.1	0.13	0.15
16	-0.43	-0.38	-0.34	-0.31	-0.28	-0.26	-0.28	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	1	0.3	0.26	0.24	0.23	0.21	0.2
17	-0.13	-0.38	-0.36	-0.34	-0.31	-0.29	-0.34	0.06	0.05	0.05	0.04	0.04	0.05	0.05	0.05	0.3	1	0.29	0.28	0.26	0.25	0.24
18	-0.11	-0.16	-0.38	-0.37	-0.36	-0.33	-0.41	0.08	0.06	0.06	0.05	0.06	0.06	0.07	0.07	0.26	0.29	1	0.32	0.31	0.3	0.29
19	-0.11	-0.15	-0.2	-0.41	-0.4	-0.39	-0.49	0.1	0.08	0.07	0.07	0.07	0.07	0.08	0.09	0.24	0.28	0.32	1	0.37	0.36	0.35
20	-0.1	-0.14	-0.19	-0.24	-0.44	-0.44	-0.58	0.13	0.09	0.08	0.08	0.08	0.09	0.1	0.1	0.23	0.26	0.31	0.37	1	0.42	0.41
21	-0.09	-0.14	-0.18	-0.23	-0.28	-0.48	-0.65	0.16	0.1	0.1	0.09	0.1	0.1	0.12	0.13	0.21	0.25	0.3	0.36	0.42	1	0.47
22	-0.09	-0.13	-0.17	-0.22	-0.27	-0.33	-0.72	0.2	0.12	0.11	0.11	0.11	0.13	0.15	0.15	0.2	0.24	0.29	0.35	0.41	0.47	1

Table 56. Fall spawner ADAPT-VPA FRATIO split CUE (ages 4-10) and acoustic (ages 4-9).

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.001745
MEAN SQUARE RESIDUALS 0.209665

Estimates for parameters

PAR. EST.	STD. ERR.	REL. ERR.	BIAS	REL. BIAS
1.24E1	3.76E-1	0.030	1.23E-2	0.001
1.21E1	2.97E-1	0.025	1.05E-2	0.001
1.16E1	3.10E-1	0.027	7.37E-3	0.001
9.83E0	3.32E-1	0.034	5.02E-3	0.001
1.09E1	2.97E-1	0.027	6.46E-3	0.001
9.56E0	2.91E-1	0.030	6.33E-3	0.001
1.08E1	3.73E-1	0.034	-6.68E-3	-0.001
2.11E-1	1.25E-1	0.592	7.82E-3	0.037
-5.60E0	2.40E-1	-0.043	-1.39E-2	0.002
-5.48E0	2.34E-1	-0.043	-1.33E-2	0.002
-5.68E0	2.39E-1	-0.042	-1.28E-2	0.002
-5.49E0	2.49E-1	-0.045	-1.15E-2	0.002
-5.73E0	2.58E-1	-0.045	-1.10E-2	0.002
-5.95E0	2.69E-1	-0.045	-1.01E-2	0.002
-5.18E0	1.24E-1	-0.024	-2.65E-3	0.001
-4.87E0	1.25E-1	-0.026	-2.68E-3	0.001
-4.78E0	1.26E-1	-0.026	-2.77E-3	0.001
-4.52E0	1.29E-1	-0.028	-3.01E-3	0.001
-4.35E0	1.33E-1	-0.031	-3.33E-3	0.001
-4.41E0	1.43E-1	-0.033	-4.07E-3	0.001
-4.26E0	1.50E-1	-0.035	-4.90E-3	0.001
-6.03E0	1.99E-1	-0.033	-1.29E-2	0.002
-4.61E0	1.96E-1	-0.042	-1.20E-2	0.003
-4.28E0	1.99E-1	-0.047	-1.14E-2	0.003
-4.19E0	2.06E-1	-0.049	-1.06E-2	0.003
-4.29E0	2.12E-1	-0.049	-1.01E-2	0.002
-4.18E0	2.19E-1	-0.052	-9.30E-3	0.002
-4.13E0	2.31E-1	-0.056	-8.08E-3	0.002

Parameters in linear scale

PAR. EST.	STD. ERR.	REL. ERR.	BIAS	REL. BIAS
2.32E5	8.73E4	0.376	1.93E4	0.083
1.85E5	5.50E4	0.297	1.01E4	0.055
1.11E5	3.45E4	0.310	6.17E3	0.055
1.87E4	6.19E3	0.332	1.12E3	0.060
5.47E4	1.63E4	0.297	2.77E3	0.051
1.42E4	4.12E3	0.291	6.88E2	0.049
5.15E4	1.92E4	0.373	3.24E3	0.063
1.23E0	1.54E-1	0.125	1.93E-2	0.016
3.70E-3	8.89E-4	0.240	5.53E-5	0.015
4.17E-3	9.75E-4	0.234	5.86E-5	0.014
3.43E-3	8.20E-4	0.239	5.43E-5	0.016
4.12E-3	1.03E-3	0.249	8.04E-5	0.019
3.25E-3	8.37E-4	0.258	7.24E-5	0.022
2.61E-3	7.03E-4	0.269	6.80E-5	0.026
5.64E-3	7.01E-4	0.124	2.86E-5	0.005
7.64E-3	9.54E-4	0.125	3.91E-5	0.005
8.38E-3	1.06E-3	0.126	4.33E-5	0.005
1.08E-2	1.39E-3	0.129	5.70E-5	0.005
1.29E-2	1.73E-3	0.133	7.22E-5	0.006
1.22E-2	1.75E-3	0.143	7.56E-5	0.006
1.41E-2	2.12E-3	0.150	9.01E-5	0.006
2.40E-3	4.79E-4	0.199	1.68E-5	0.007
9.93E-3	1.94E-3	0.196	7.05E-5	0.007
1.39E-2	2.77E-3	0.199	1.18E-4	0.008
1.52E-2	3.14E-3	0.206	1.62E-4	0.011
1.37E-2	2.91E-3	0.212	1.69E-4	0.012
1.52E-2	3.34E-3	0.219	2.24E-4	0.015
1.60E-2	3.70E-3	0.231	2.97E-4	0.019

Table 57. Fall spawner ADAPT-VPA FRATIO split CUE and acoustic parameter correlations.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	1	0.19	0.17	0.15	0.15	0.13	0.13	-0.02	-0.4	-0.12	-0.11	-0.11	-0.1	-0.09	-0.02	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.35	-0.12	-0.11	-0.1	-0.09	-0.09	-0.09
2	0.19	1	0.24	0.22	0.22	0.2	0.2	-0.03	-0.34	-0.36	-0.16	-0.16	-0.15	-0.14	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.03	-0.31	-0.32	-0.16	-0.15	-0.14	-0.13	-0.13
3	0.17	0.24	1	0.29	0.29	0.27	0.27	-0.05	-0.29	-0.33	-0.38	-0.21	-0.21	-0.2	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.04	-0.28	-0.3	-0.35	-0.2	-0.19	-0.18	-0.18
4	0.15	0.22	0.29	1	0.35	0.34	0.36	-0.06	-0.25	-0.29	-0.35	-0.43	-0.26	-0.26	-0.04	-0.04	-0.04	-0.04	-0.04	-0.05	-0.05	-0.26	-0.28	-0.33	-0.39	-0.25	-0.24	-0.24
5	0.15	0.22	0.29	0.35	1	0.41	0.46	-0.08	-0.25	-0.29	-0.35	-0.41	-0.45	-0.32	-0.05	-0.05	-0.05	-0.05	-0.05	-0.06	-0.06	-0.26	-0.29	-0.34	-0.38	-0.42	-0.3	-0.3
6	0.13	0.2	0.27	0.34	0.41	1	0.55	-0.11	-0.18	-0.26	-0.34	-0.41	-0.46	-0.49	-0.07	-0.06	-0.06	-0.06	-0.07	-0.08	-0.08	-0.25	-0.28	-0.33	-0.39	-0.43	-0.45	-0.36
7	0.13	0.2	0.27	0.36	0.46	0.55	1	-0.27	-0.19	-0.24	-0.34	-0.44	-0.54	-0.62	-0.13	-0.12	-0.12	-0.13	-0.15	-0.18	-0.19	-0.25	-0.3	-0.37	-0.45	-0.53	-0.59	-0.66
8	-0.02	-0.03	-0.05	-0.06	-0.08	-0.11	-0.27	1	0.03	0.04	0.05	0.07	0.1	0.12	0.15	0.18	0.23	0.3	0.4	0.52	0.58	0.04	0.05	0.07	0.08	0.1	0.13	0.17
9	-0.4	-0.34	-0.29	-0.25	-0.25	-0.18	-0.19	0.03	1	0.21	0.18	0.17	0.15	0.13	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.26	0.19	0.17	0.16	0.14	0.13	0.12
10	-0.12	-0.36	-0.33	-0.29	-0.29	-0.26	-0.24	0.04	0.21	1	0.22	0.21	0.19	0.18	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.21	0.22	0.2	0.19	0.18	0.17	0.16
11	-0.11	-0.16	-0.38	-0.35	-0.35	-0.34	-0.34	0.05	0.18	0.22	1	0.26	0.25	0.24	0.04	0.04	0.03	0.03	0.04	0.04	0.04	0.19	0.22	0.25	0.25	0.24	0.23	0.22
12	-0.11	-0.16	-0.21	-0.43	-0.41	-0.41	-0.44	0.07	0.17	0.21	0.26	1	0.32	0.31	0.05	0.05	0.04	0.05	0.05	0.06	0.06	0.19	0.22	0.26	0.31	0.3	0.29	0.29
13	-0.1	-0.15	-0.21	-0.26	-0.45	-0.46	-0.54	0.1	0.15	0.19	0.25	0.32	1	0.37	0.07	0.06	0.06	0.06	0.06	0.07	0.08	0.19	0.22	0.26	0.31	0.35	0.35	0.36
14	-0.09	-0.14	-0.2	-0.26	-0.32	-0.49	-0.62	0.12	0.13	0.18	0.24	0.31	0.37	1	0.08	0.07	0.07	0.07	0.08	0.09	0.1	0.18	0.21	0.26	0.31	0.36	0.4	0.41
15	-0.02	-0.02	-0.03	-0.04	-0.05	-0.07	-0.13	0.15	0.02	0.03	0.04	0.05	0.07	0.08	1	0.03	0.04	0.05	0.06	0.08	0.09	0.03	0.04	0.04	0.05	0.06	0.07	0.09
16	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.12	0.18	0.02	0.03	0.04	0.05	0.06	0.07	0.03	1	0.05	0.06	0.08	0.1	0.11	0.03	0.03	0.04	0.05	0.06	0.07	0.08
17	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.12	0.23	0.02	0.02	0.03	0.04	0.06	0.07	0.04	0.05	1	0.07	0.09	0.12	0.14	0.02	0.03	0.04	0.05	0.06	0.07	0.08
18	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.13	0.3	0.02	0.02	0.03	0.05	0.06	0.07	0.05	0.06	0.07	1	0.12	0.16	0.18	0.02	0.03	0.04	0.05	0.06	0.07	0.09
19	-0.01	-0.02	-0.03	-0.04	-0.05	-0.07	-0.15	0.4	0.02	0.03	0.04	0.05	0.06	0.08	0.06	0.08	0.09	0.12	1	0.21	0.23	0.03	0.03	0.04	0.05	0.06	0.08	0.1
20	-0.02	-0.02	-0.03	-0.05	-0.06	-0.08	-0.18	0.52	0.02	0.03	0.04	0.06	0.07	0.09	0.08	0.1	0.12	0.16	0.21	1	0.3	0.03	0.04	0.05	0.06	0.07	0.09	0.12
21	-0.02	-0.03	-0.04	-0.05	-0.06	-0.08	-0.19	0.58	0.03	0.03	0.04	0.06	0.08	0.1	0.09	0.11	0.14	0.18	0.23	0.3	1	0.03	0.04	0.05	0.07	0.08	0.1	0.12
22	-0.35	-0.31	-0.28	-0.26	-0.26	-0.25	-0.25	0.04	0.26	0.21	0.19	0.19	0.19	0.18	0.03	0.03	0.02	0.02	0.03	0.03	0.03	1	0.2	0.19	0.18	0.18	0.17	0.16
23	-0.12	-0.32	-0.3	-0.28	-0.29	-0.28	-0.3	0.05	0.19	0.22	0.22	0.22	0.22	0.21	0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.2	1	0.21	0.21	0.2	0.2	0.2
24	-0.11	-0.16	-0.35	-0.33	-0.34	-0.33	-0.37	0.07	0.17	0.2	0.25	0.26	0.26	0.26	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.19	0.21	1	0.25	0.25	0.24	0.24
25	-0.1	-0.15	-0.2	-0.39	-0.38	-0.39	-0.45	0.08	0.16	0.19	0.25	0.31	0.31	0.31	0.05	0.05	0.05	0.05	0.05	0.06	0.07	0.18	0.21	0.25	1	0.29	0.29	0.3
26	-0.09	-0.14	-0.19	-0.25	-0.42	-0.43	-0.53	0.1	0.14	0.18	0.24	0.3	0.35	0.36	0.06	0.06	0.06	0.06	0.06	0.07	0.08	0.18	0.2	0.25	0.29	1	0.34	0.35
27	-0.09	-0.13	-0.18	-0.24	-0.3	-0.45	-0.59	0.13	0.13	0.17	0.23	0.29	0.35	0.4	0.07	0.07	0.07	0.07	0.08	0.09	0.1	0.17	0.2	0.24	0.29	0.34	1	0.39
28	-0.09	-0.13	-0.18	-0.24	-0.3	-0.36	-0.66	0.17	0.12	0.16	0.22	0.29	0.36	0.41	0.09	0.08	0.08	0.09	0.1	0.12	0.12	0.16	0.2	0.24	0.3	0.35	0.39	1

Table 58. Fall spawner population beginning of year numbers, biomass, and annual fishing mortality from ADAPT-VPA split CUE FRATIO model.

Numbers

	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
2	136355	368380	315616	496143	748620	461266	494853	707008	471016	323739	351015	1154018	769995	225889	661267	259373	995975	810363				
3	142415	110242	293872	256437	405506	611032	376317	404220	577874	384719	264261	283519	952338	630362	184777	541297	212313	815422	663457			
4	96022	93564	75506	197377	200193	322679	492400	303725	326304	468486	305469	212160	230598	772637	510131	150479	441239	173548	664874	540772	870240	264107
5	77463	47626	48534	41182	129751	145349	238409	374624	233294	230865	343926	228035	156834	163521	576503	400905	118461	344718	134862	513913	420535	689093
6	27348	38628	19299	22619	26852	87525	106591	177922	277382	168266	158142	238321	160555	103878	119114	408823	298007	82877	223799	66031	352882	310704
7	21917	17248	14058	7831	15859	16945	58328	77629	127027	188821	110990	108138	161649	103007	76708	82695	292308	191629	47134	132553	57870	242671
8	29030	12831	9101	2697	5201	10307	11560	41518	52717	79403	114211	70502	70210	79295	72864	53565	58954	166739	105567	25560	84110	36375
9	4683	10572	6237	1585	1407	3192	6884	8115	26299	32337	44899	73270	44659	40058	51191	50022	36532	35058	89188	62291	16424	51760
10	2854	2033	3186	1117	618	686	2079	5143	4898	17758	15987	26469	47608	24363	26830	31956	35850	21591	19808	49205	43006	10419
11	29240	12870	1737	450	815	818	898	2144	4389	6019	13284	16585	26275	40541	43974	41451	47462	43016	31885	25880	50339	61617
4+	288557	235373	177658	274858	380496	587500	917148	990819	1054311	1191956	1106908	971481	898386	1327299	1477313	1219895	1328824	1059176	1317116	1438205	1895406	1666746
5+	192535	141809	102151	77462	160303	264822	424747	687094	726007	723470	601439	759321	667790	554662	967182	1069416	887585	885628	652242	897432	1025167	1402639
7+	87724	55554	34317	13881	23700	31948	79747	134548	217331	324338	299371	292965	350401	287264	271586	259688	473116	458033	293580	295489	251750	402842

Biomass

	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
2	13785	40780	35144	51500	86391	63701	62005	78902	53790	25802	33662	122668	121351	18987	43710	13539	90833	69205				
3	19117	13876	38320	37553	56782	88965	63164	65304	78440	60730	31698	36402	135652	97564	23247	52424	17974	85390	75311			
4	17337	16426	13239	37651	44417	69119	104355	67540	72699	93469	72365	44924	46974	158205	90640	24165	71568	27413	102872	92937	152455	44174
5	18214	10965	11241	10031	34184	38405	61707	96700	60058	59132	90154	61598	40796	40139	133308	87261	24090	67735	27754	109741	86476	144647
6	7399	10090	4786	6840	8497	26539	31085	52956	82937	48766	46695	71643	48383	29276	30859	101241	70954	18778	61147	21469	85330	73971
7	6365	4887	3844	2462	5686	5726	19130	25653	42181	61484	36086	34767	53266	33280	22337	22012	77154	49924	11696	34267	15511	62965
8	8962	3992	2502	917	1981	3794	4246	14658	18829	27774	39708	24111	24619	27400	23978	15467	16850	47114	30006	7187	23306	10216
9	1536	3714	1958	506	549	1237	2646	3200	10829	11908	16850	26556	15807	14370	17601	16535	11932	10925	27067	19186	5095	15901
10	996	712	1098	394	234	251	774	1897	1876	6871	6224	10345	17917	9002	9379	10230	12167	7393	6812	18193	14043	3437
11	10602	4674	641	169	345	327	359	864	1775	2387	5353	6635	10354	15804	16261	14113	15918	15553	11774	9412	17683	22269
4+	71611	55460	39308	58970	95694	145398	224301	265498	290984	311790	313437	280479	258116	327476	344364	291024	300433	244836	268918	310392	401903	377280
5+	54274	39033	26069	21320	61477	76279	119947	197947	218288	218321	241071	235555	211144	169272	253724	266858	228885	217422	166046	217485	249448	333106
7+	28661	17979	10942	4448	8798	11334	27154	46291	75291	110424	104222	102414	121964	99896	89587	78386	133829	130910	87148	88245	75641	114488

Fishing Mortality

	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
2	0.013	0.026	0.011	0.002	0.003	0.004	0.002	0.002	0.002	0.003	0.014	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000
3	0.220	0.178	0.198	0.048	0.028	0.016	0.014	0.014	0.010	0.031	0.020	0.007	0.009	0.012	0.005	0.004	0.002	0.004	0.004	0.006	0.014
4	0.501	0.456	0.406	0.219	0.120	0.103	0.073	0.064	0.146	0.109	0.092	0.102	0.144	0.093	0.041	0.039	0.047	0.052	0.058	0.051	0.033
5	0.496	0.703	0.563	0.228	0.194	0.110	0.093	0.101	0.127	0.178	0.167	0.151	0.212	0.117	0.144	0.103	0.157	0.232	0.227	0.176	0.103
6	0.261	0.811	0.702	0.168	0.260	0.206	0.117	0.137	0.185	0.216	0.199	0.188	0.244	0.103	0.165	0.135	0.235	0.364	0.324	0.219	0.174
7	0.335	0.439	1.451	0.209	0.218	0.182	0.140	0.187	0.270	0.303	0.254	0.213	0.512	0.146	0.159	0.138	0.361	0.396	0.412	0.255	0.264
8	0.810	0.621	1.548	0.451	0.286	0.204	0.154	0.183	0.289	0.370	0.244	0.257	0.361	0.238	0.176	0.129	0.320	0.426	0.328	0.242	0.285
9	0.634	1.000	1.520	0.742	0.518	0.229	0.092	0.305	0.266	0.504	0.328	0.231	0.408	0.201	0.271	0.133	0.379	0.371	0.395	0.170	0.255
10	0.597	1.647	2.048	0.426	0.322	0.283	0.120	0.289	0.212	0.363	0.336	0.272	0.372	0.167	0.298	0.211	0.411	0.443	0.435	0.186	0.193
11+	0.726	2.003	2.491	0.520	0.392	0.344	0.146	0.351	0.258	0.441	0.408	0.330	0.453	0.203	0.360	0.256	0.500	0.539	0.529	0.226	0.235
Ave 5-9 F	0.51	0.69	1.16	0.36	0.30	0.19	0.12	0.18	0.23	0.31	0.24	0.21	0.35	0.16	0.18	0.13	0.29	0.36	0.34	0.21	0.22
Wt 4+ F	0.50	0.61	0.69	0.22	0.15	0.13	0.09	0.11	0.18	0.20	0.18	0.17	0.29	0.11	0.12	0.11	0.20	0.28	0.19	0.14	0.10
Ave 5-9 ER	0.36	0.46	0.63	0.28	0.23	0.15	0.10	0.15	0.19	0.25	0.19	0.17	0.27	0.14	0.15	0.11	0.23	0.27	0.26	0.17	0.18
Wt 4+ ER	0.36	0.42	0.46	0.16	0.14	0.11	0.08	0.09	0.15	0.17	0.15	0.14	0.23	0.10	0.10	0.10	0.17	0.23	0.15	0.12	0.09

Table 59. Fall spawner sum of fishing mortality along cohorts.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	0.01	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.22	0.18	0.20	0.05	0.03	0.02	0.01	0.01	0.01	0.03	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01
4	0.50	0.46	0.41	0.22	0.12	0.10	0.07	0.06	0.15	0.11	0.09	0.10	0.14	0.09	0.04	0.04	0.05	0.05	0.06	0.05	0.03
5	0.50	0.70	0.56	0.23	0.19	0.11	0.09	0.10	0.13	0.18	0.17	0.15	0.21	0.12	0.14	0.10	0.16	0.23	0.23	0.18	0.10
6	0.26	0.81	0.70	0.17	0.26	0.21	0.12	0.14	0.19	0.22	0.20	0.19	0.24	0.10	0.17	0.14	0.24	0.36	0.32	0.22	0.17
7	0.34	0.44	1.45	0.21	0.22	0.18	0.14	0.19	0.27	0.30	0.25	0.21	0.51	0.15	0.16	0.14	0.36	0.40	0.41	0.26	0.26
8	0.81	0.52	1.55	0.45	0.29	0.20	0.15	0.18	0.29	0.37	0.24	0.26	0.36	0.24	0.18	0.13	0.32	0.43	0.33	0.24	0.29
9	0.63	1.00	1.52	0.74	0.52	0.23	0.09	0.31	0.27	0.50	0.33	0.23	0.41	0.20	0.27	0.13	0.38	0.37	0.40	0.17	0.26
10	0.60	1.65	2.05	0.43	0.32	0.28	0.12	0.29	0.21	0.36	0.34	0.27	0.37	0.17	0.30	0.21	0.41	0.44	0.44	0.19	0.19
11+	0.73	2.00	2.49	0.52	0.39	0.34	0.15	0.35	0.26	0.44	0.41	0.33	0.45	0.20	0.36	0.26	0.50	0.54	0.53	0.23	0.24
Ave 5-9 F	0.51	0.69	1.16	0.36	0.30	0.19	0.12	0.18	0.23	0.31	0.24	0.21	0.35	0.16	0.18	0.13	0.29	0.36	0.34	0.21	0.22
Wt 4+ F	0.50	0.61	0.69	0.22	0.16	0.13	0.09	0.11	0.18	0.20	0.18	0.17	0.29	0.11	0.12	0.11	0.20	0.28	0.19	0.14	0.10
Ave 5-9 ER	40	50	69	30	26	17	11	17	20	27	21	19	29	15	17	12	25	30	29	19	19
Wt 4+ ER	39	46	50	20	15	12	9	10	16	18	16	16	25	11	11	11	19	25	17	13	10
F Sum	2.38	2.20	2.05	2.06	1.73	1.87	1.87	2.21	1.93	2.08	1.94	1.99	1.48	1.47	1.15	0.76	0.41	0.16	0.04	0.02	0.00

Table 60. Fall spawner projections with no adjustment for tendency to over-estimate four year olds showing beginning of year weights, biomass, and numbers.

	Weight			Biomass (t)			Numbers (millions)			$F_{0.1}$ Catch	
Age	Beginning of Year	Catch	Ave. PR	1998	1999	2000	1998	1999	2000	1999	2000
2	0.0543	0.0845	0.00	440721	440721	440721	22286	23951	23951	0	0
3	0.1120	0.1418	0.03	339943	339943	339943	35033	38089	38089	377	377
4	0.1673	0.2007	0.16	870240	264107	264107	152455	44174	44174	2201	2201
5	0.2099	0.2294	0.55	420535	689364	206331	88476	144703	43311	21728	6503
6	0.2381	0.2538	0.77	352882	310607	479077	85330	73948	114057	14784	22803
7	0.2582	0.2715	1.00	57870	242774	201878	15511	62692	52131	15559	12938
8	0.2808	0.2949	1.00	84110	36387	147250	23308	10219	41354	2534	10253
9	0.3072	0.3207	1.00	16424	51786	22070	5095	15909	6780	3921	1671
10	0.3298	0.3404	1.00	43006	10420	31410	14043	3437	10360	837	2524
11	0.3614	0.3787	1.00	50339	61613	43691	17683	22267	15790	5509	3906
2+				2676070	2447722	2176476	459222	439389	389996	67450	63176
4+				1895406	1667058	1395813	401903	377349	327955	67073	62799

Table 61. Fall spawner retrospective projection for 1998 using updated input data from this assessment showing beginning of year weights, biomass, and numbers.

	Weight			Biomass (t)			Numbers (millions)			$F_{0.1}$ Catch	
Age	Beginning of Year	Catch	Ave. PR	1997	1998	1999	1997	1998	1999	1998	1999
2	0.0557	0.0886	0.02	433072	433072	433072	23513	24137	24137	221	221
3	0.1126	0.1398	0.04	335262	335262	335262	40086	37750	37750	537	537
4	0.1615	0.1922	0.14	798148	870240	271016	137170	140556	43773	6427	2002
5	0.2053	0.2234	0.71	534764	420535	682304	114194	86326	140061	16372	26564
6	0.2330	0.2457	1.00	77057	352882	278350	18792	82220	64855	20470	16147
7	0.2557	0.2674	1.00	115616	57870	214034	29889	14799	54734	3654	13513
8	0.2827	0.2943	1.00	24324	84110	35100	6839	23774	9921	5844	2439
9	0.3077	0.3196	1.00	55616	16424	51015	17130	5053	15696	1239	3849
10	0.3351	0.3449	1.00	51425	43006	9962	16924	14412	3338	3502	811
11	0.3648	0.3811	1.00	32102	50339	56617	11674	18365	20656	4529	5094
2+				2457386	2663740	2366731	416211	447393	414921	62795	71176
4+				1689052	1895406	1598397	352612	385506	353033	62037	70418

Table 62. Fall spawner retrospective projection for 1998 adjusting for tendency to over-estimate 4 year-olds showing beginning of year weights, biomass, and numbers.

	Weight			Biomass (t)			Numbers (millions)			$F_{0.1}$ Catch	
Age	Beginning of Year	Catch	Ave. PR	1998	1999	2000	1998	1999	2000	1999	2000
2	0.0543	0.0845	0.00	440721	440721	440721	22288	23951	23951	0	0
3	0.1120	0.1418	0.03	339943	339943	339943	35033	38089	38089	377	377
4	0.1673	0.2007	0.16	589617	264107	264107	103294	44174	44174	2201	2201
5	0.2099	0.2294	0.55	420535	467067	206331	88476	98042	43311	14722	6503
6	0.2381	0.2538	0.77	352882	310607	324591	85330	73948	77277	14784	15450
7	0.2582	0.2715	1.00	57870	242774	201878	15511	62692	52131	15559	12938
8	0.2808	0.2949	1.00	84110	36387	147250	23308	10219	41354	2534	10253
9	0.3072	0.3207	1.00	16424	51786	22070	5095	15909	6780	3921	1671
10	0.3298	0.3404	1.00	43006	10420	31410	14043	3437	10360	837	2524
11	0.3614	0.3787	1.00	50339	61613	43691	17683	22267	15790	5509	3906
2+				2395447	2225425	2021990	410060	392727	353216	60443	55823
4+				1614784	1444762	1241327	352741	330687	291176	60066	55446

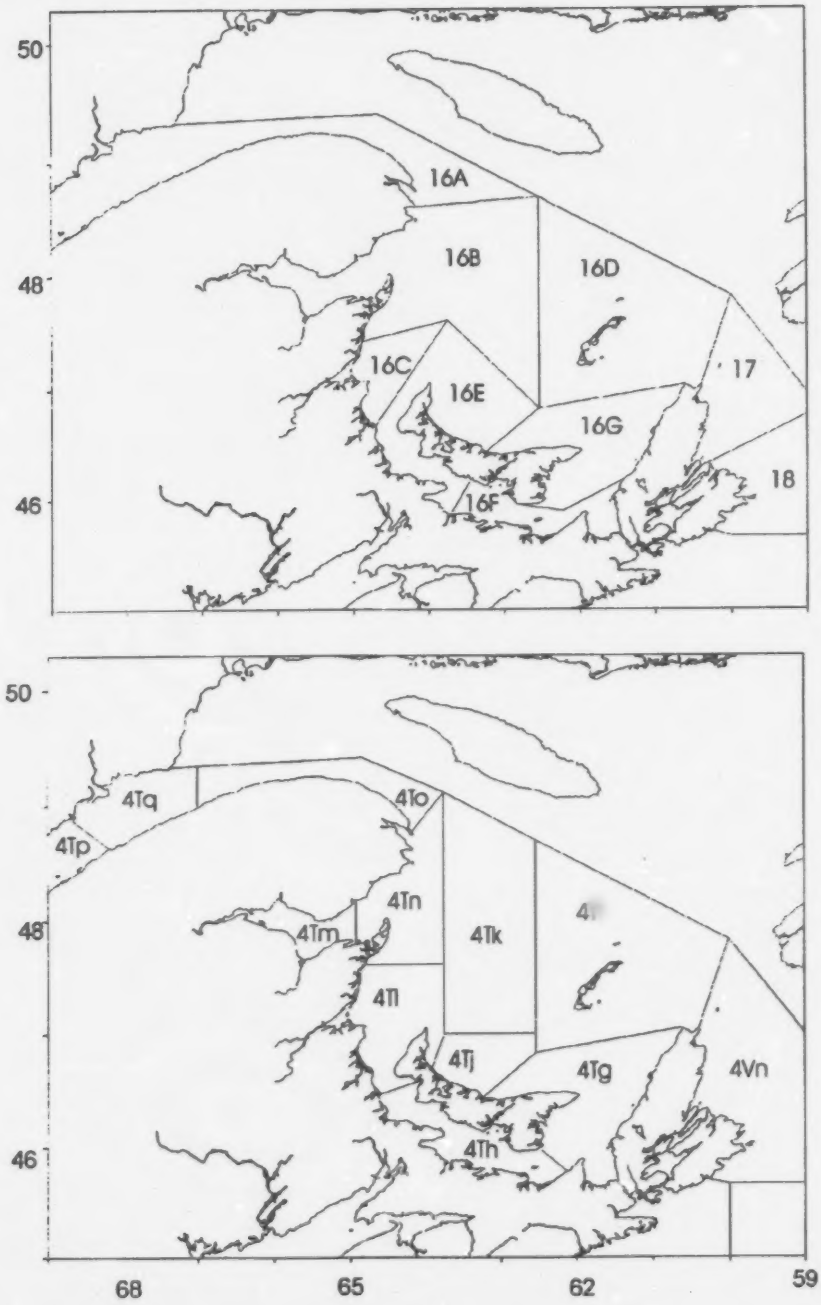


Fig. 1. Herring 4T managment zones (upper) and Canadian Statistical unit areas(lower) in Northwest Atlantic Fisheries Organization (NAFO) 4T.

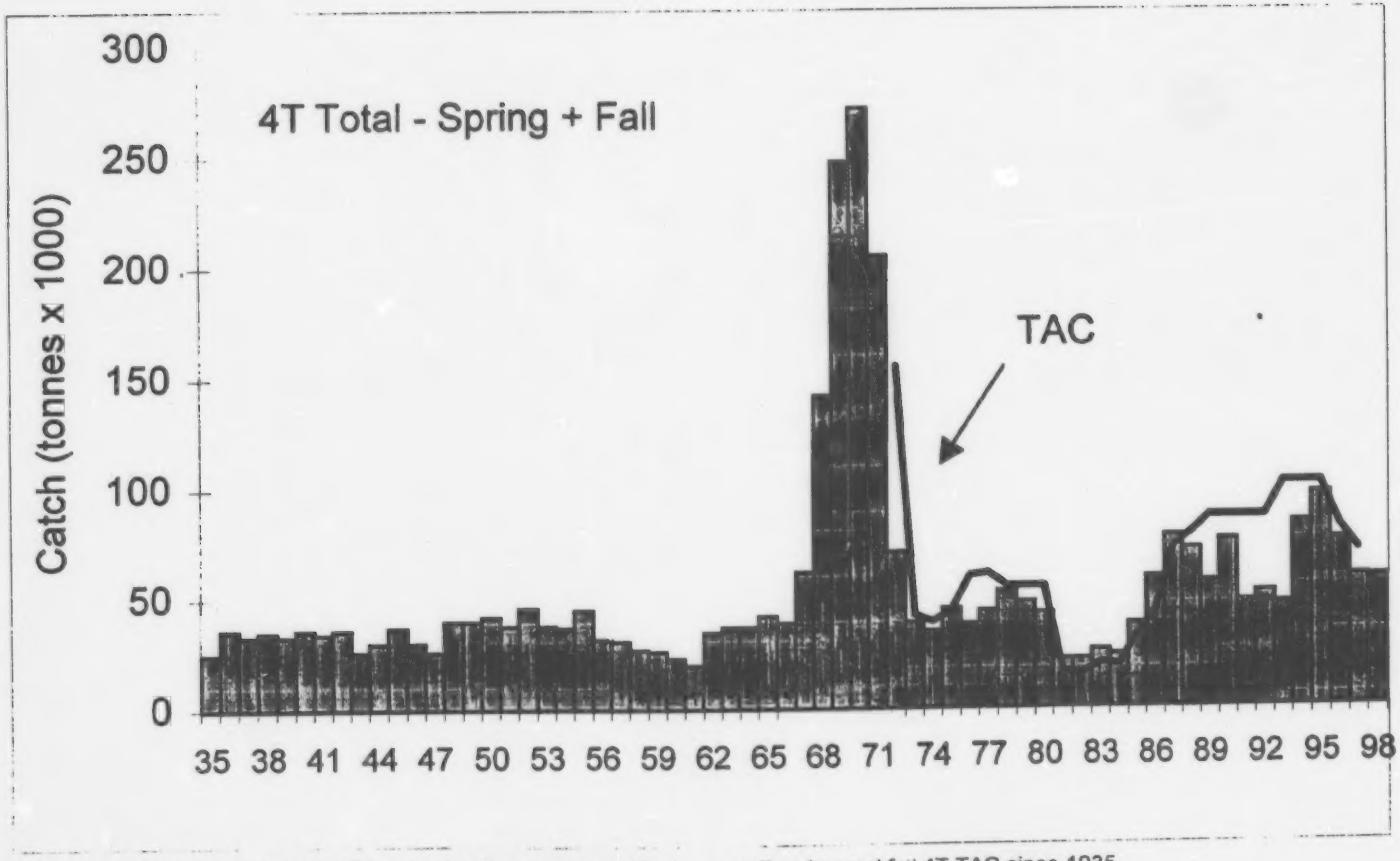
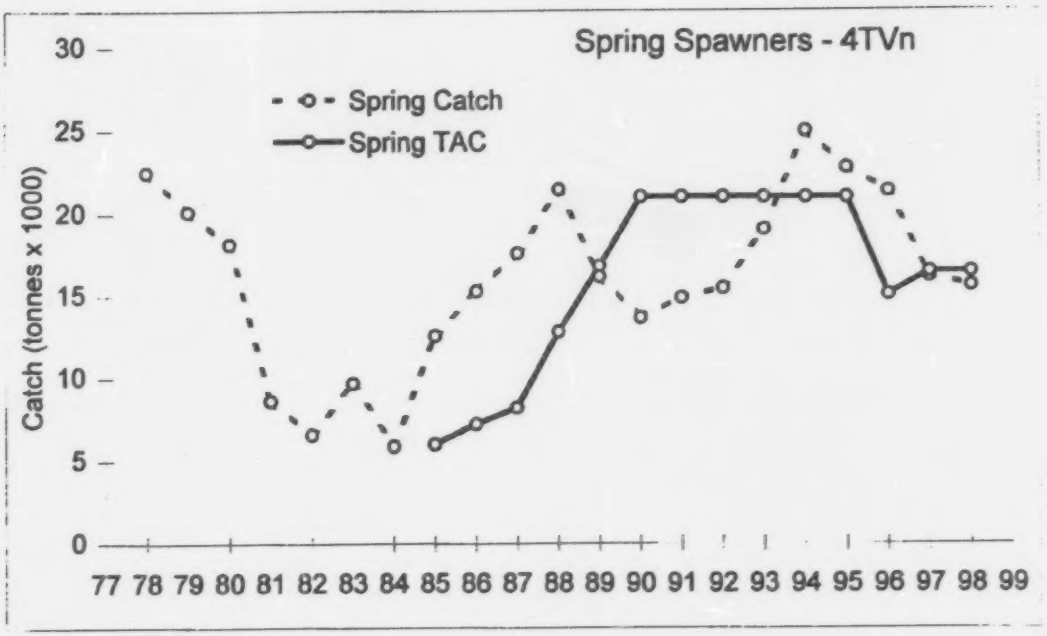


Fig. 2. Combined spring and fall 4T herring landings compared to the overall spring and fall 4T TAC since 1935



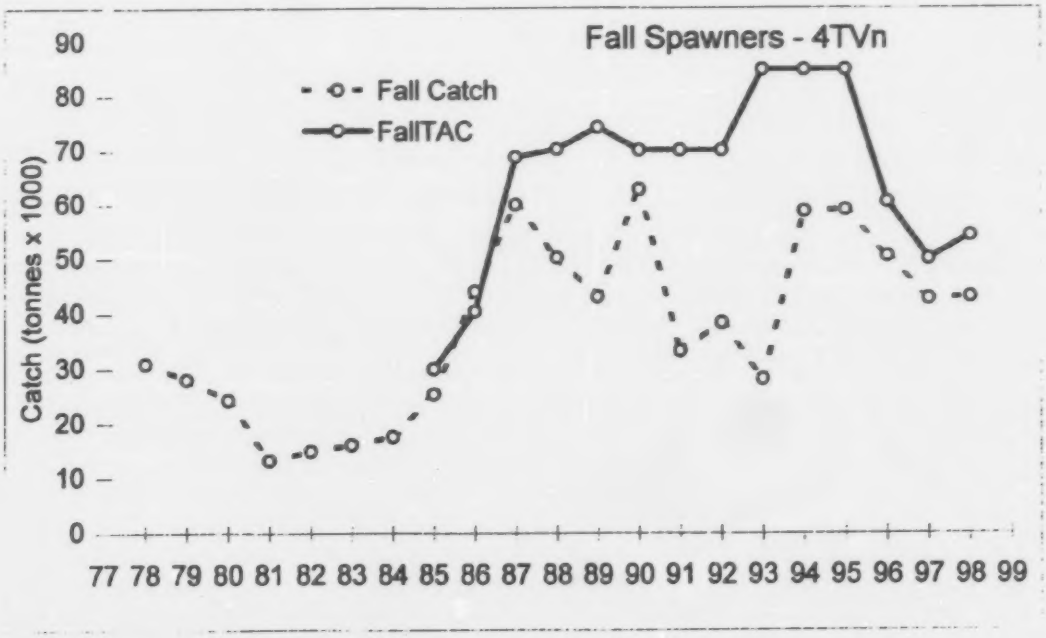


Fig. 3. Comparison of spring and fall spawners landings and TACs from 1978 to 1998 for 4T herring.

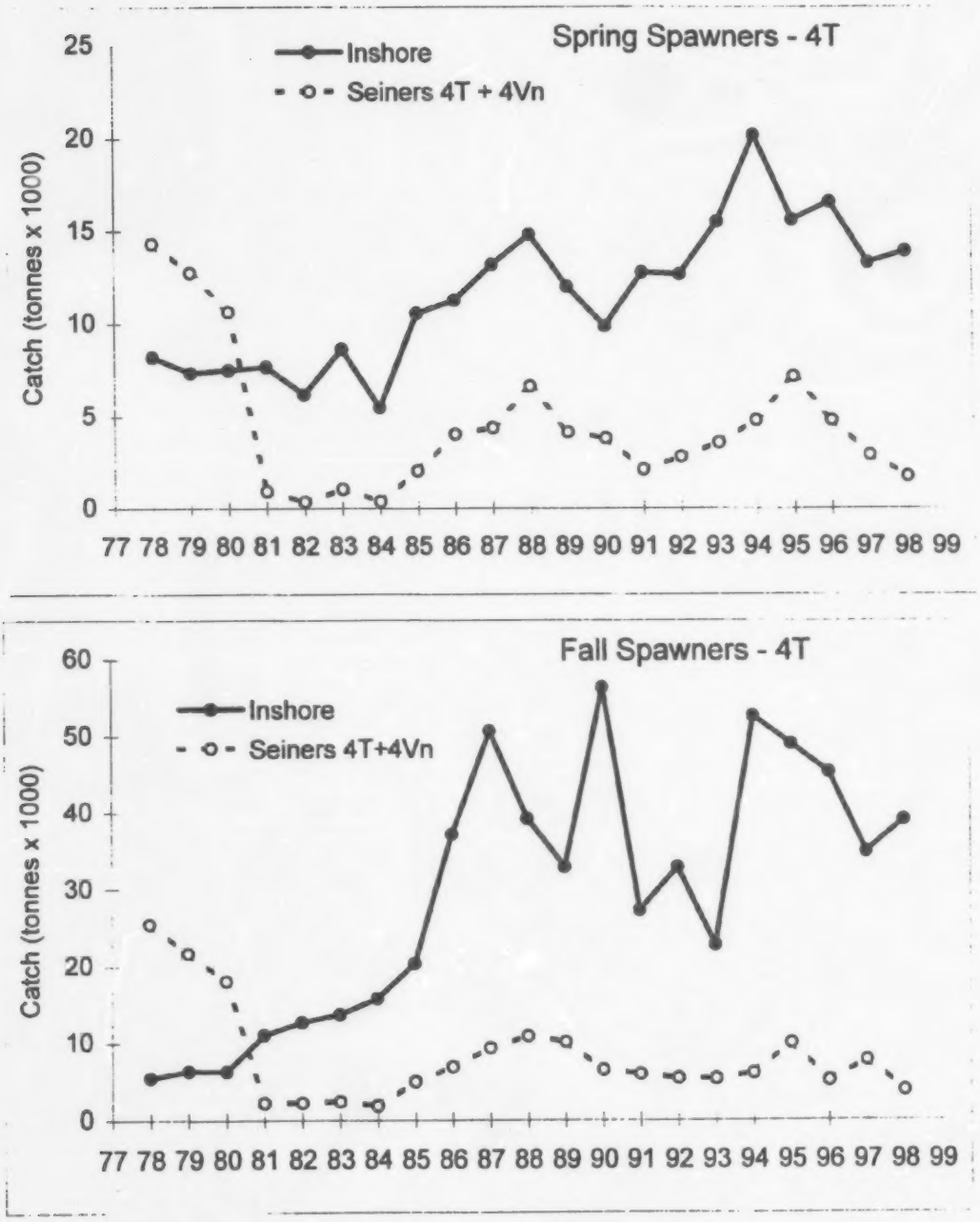


Fig. 4. Comparison of spring and fall 4T herring spawning groups by gear type.

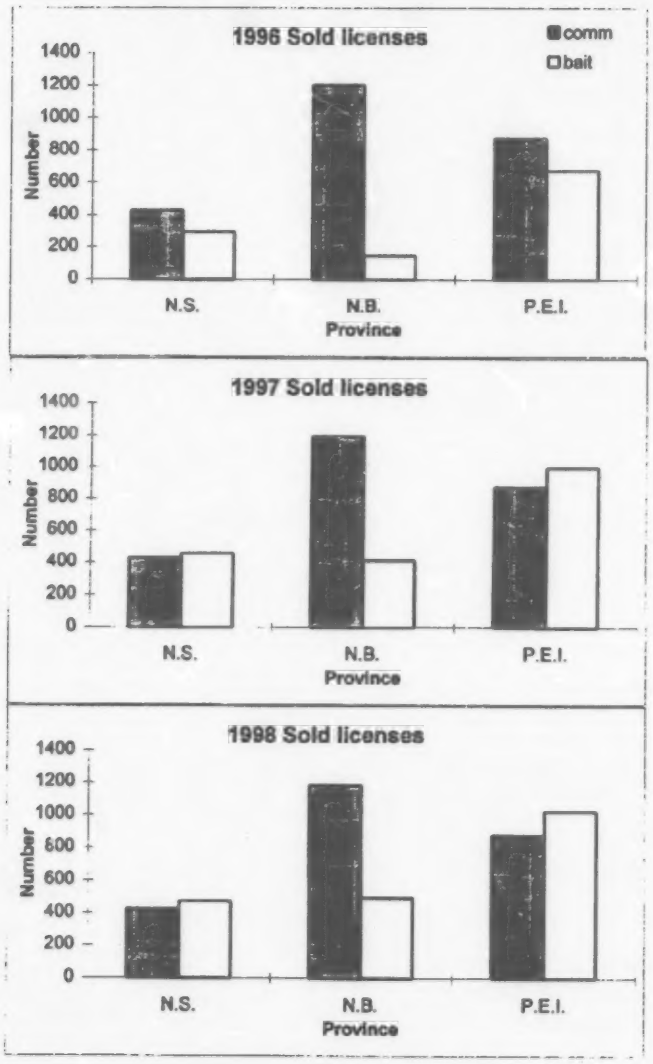


Fig. 5. Number of bait and commercial licenses sold by Maritime province in the 4T herring fishery.

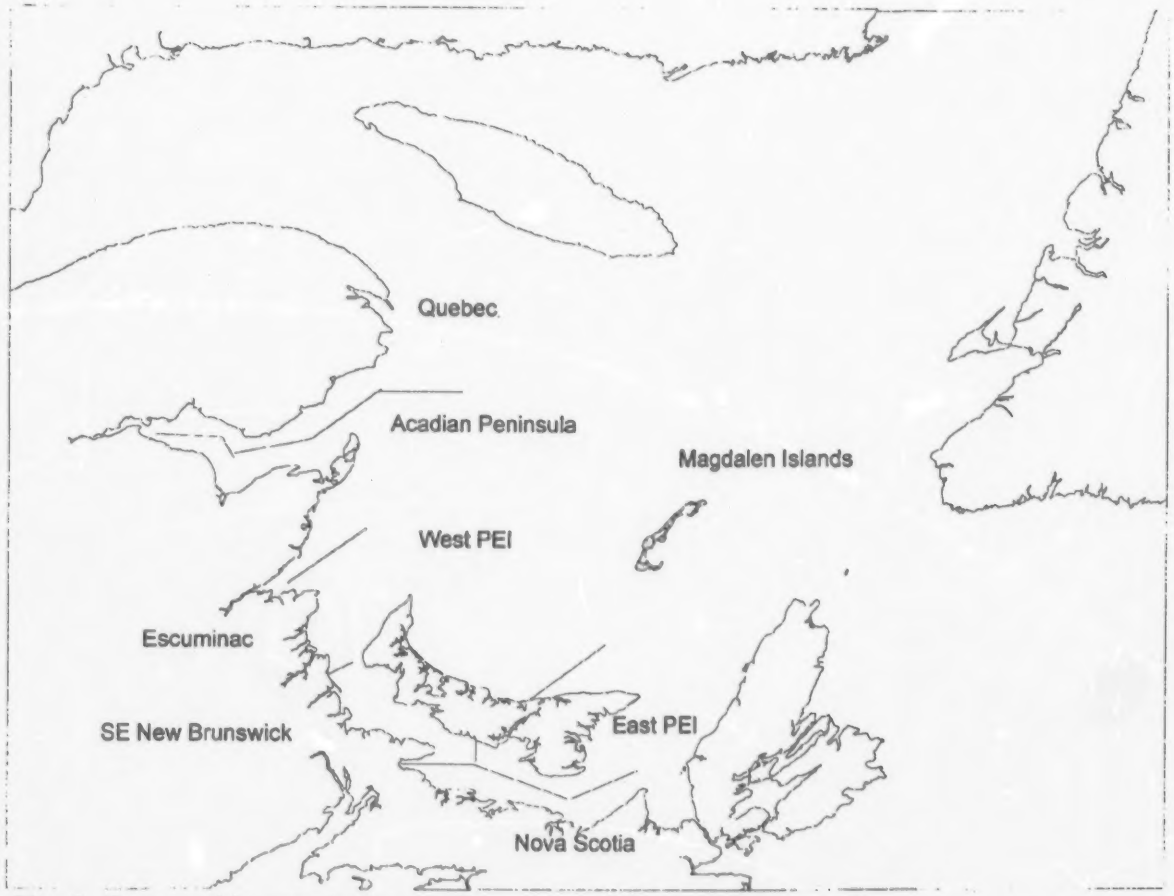


Fig. 6. Geographic ares in the southern Gulf of St. Lawrence used in the herring gillnet fishery telephone survey.

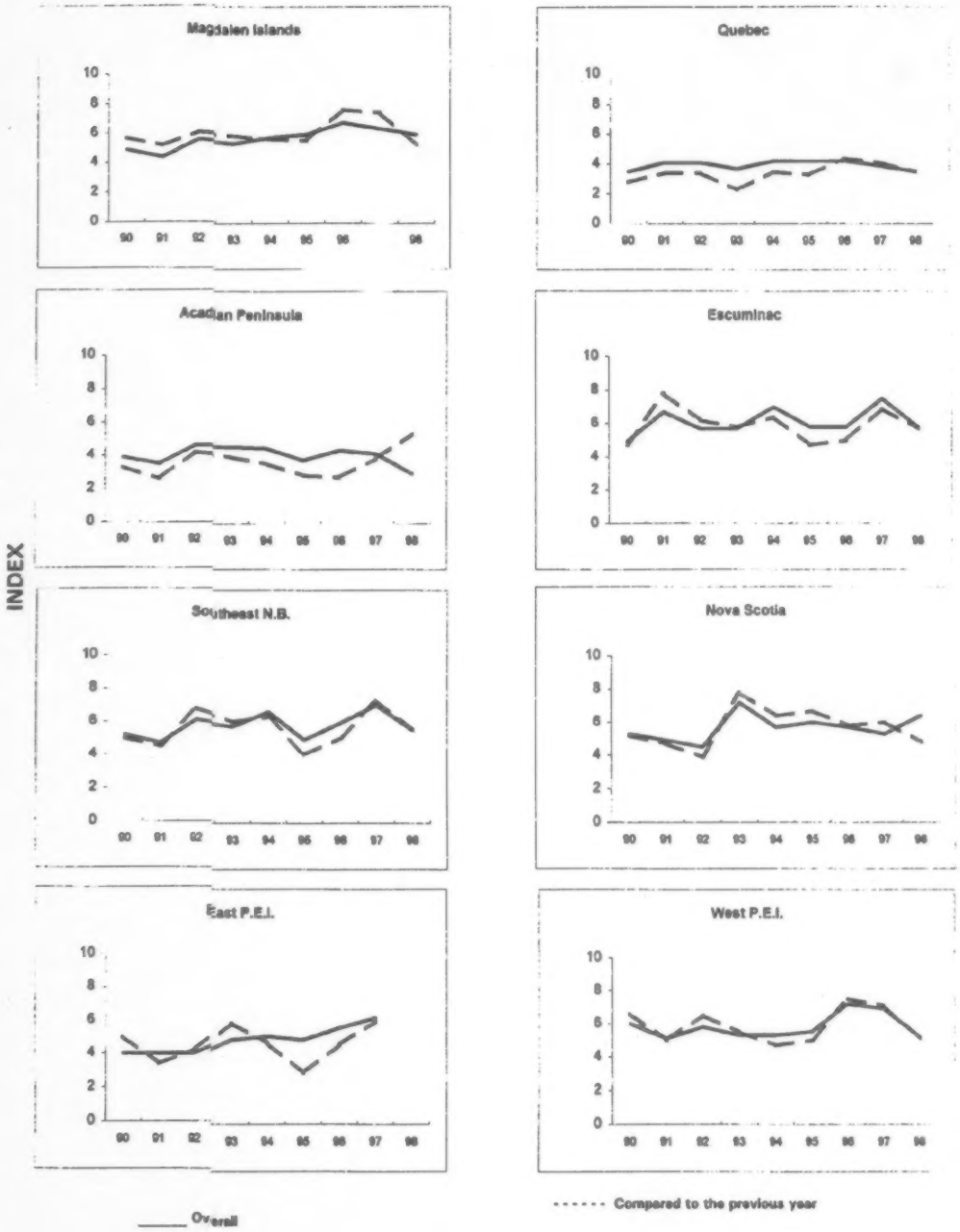


Fig. 7. Spring indices of abundance by area from phone survey.

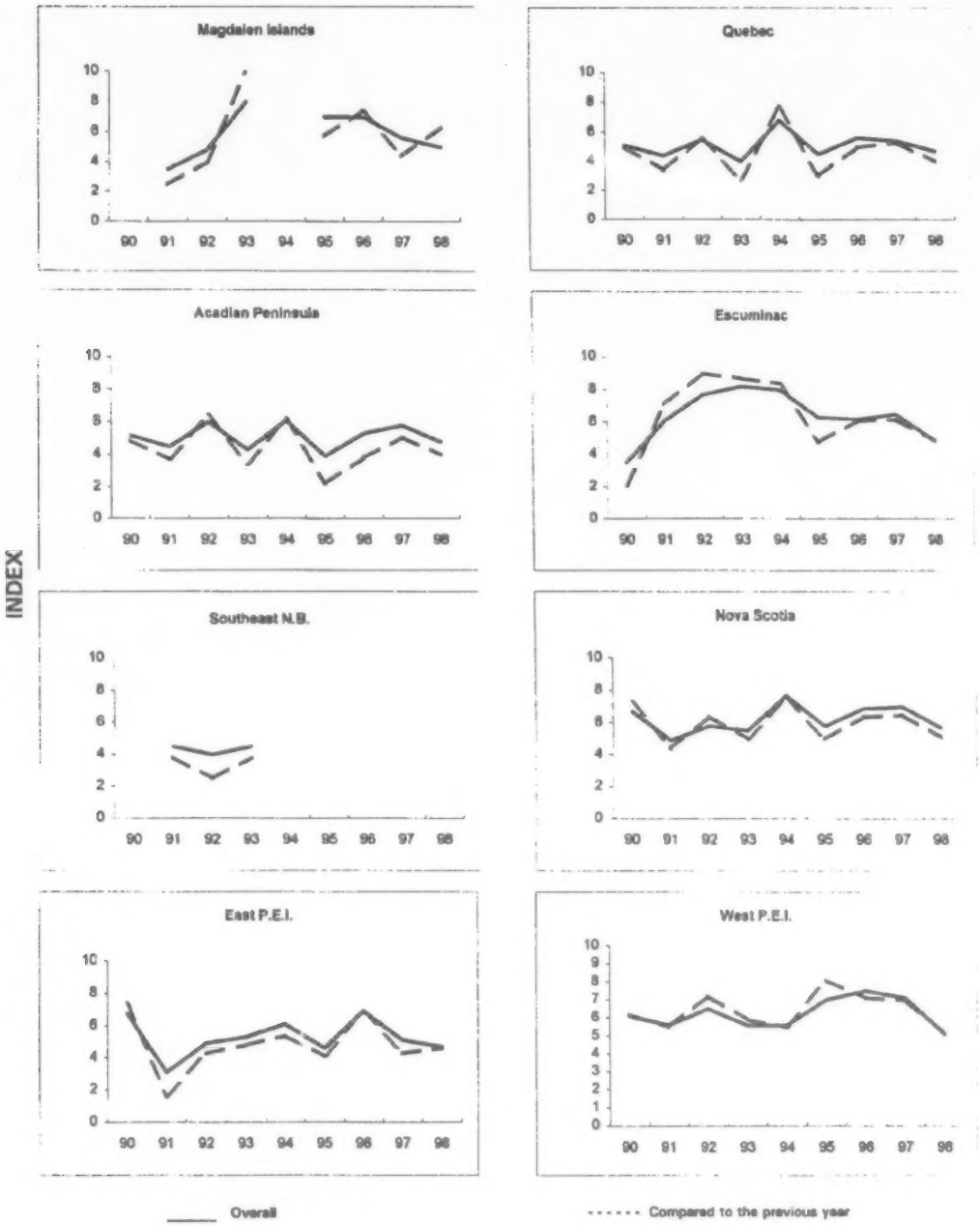


Fig. 8. Fall indices of abundance by area from phone survey

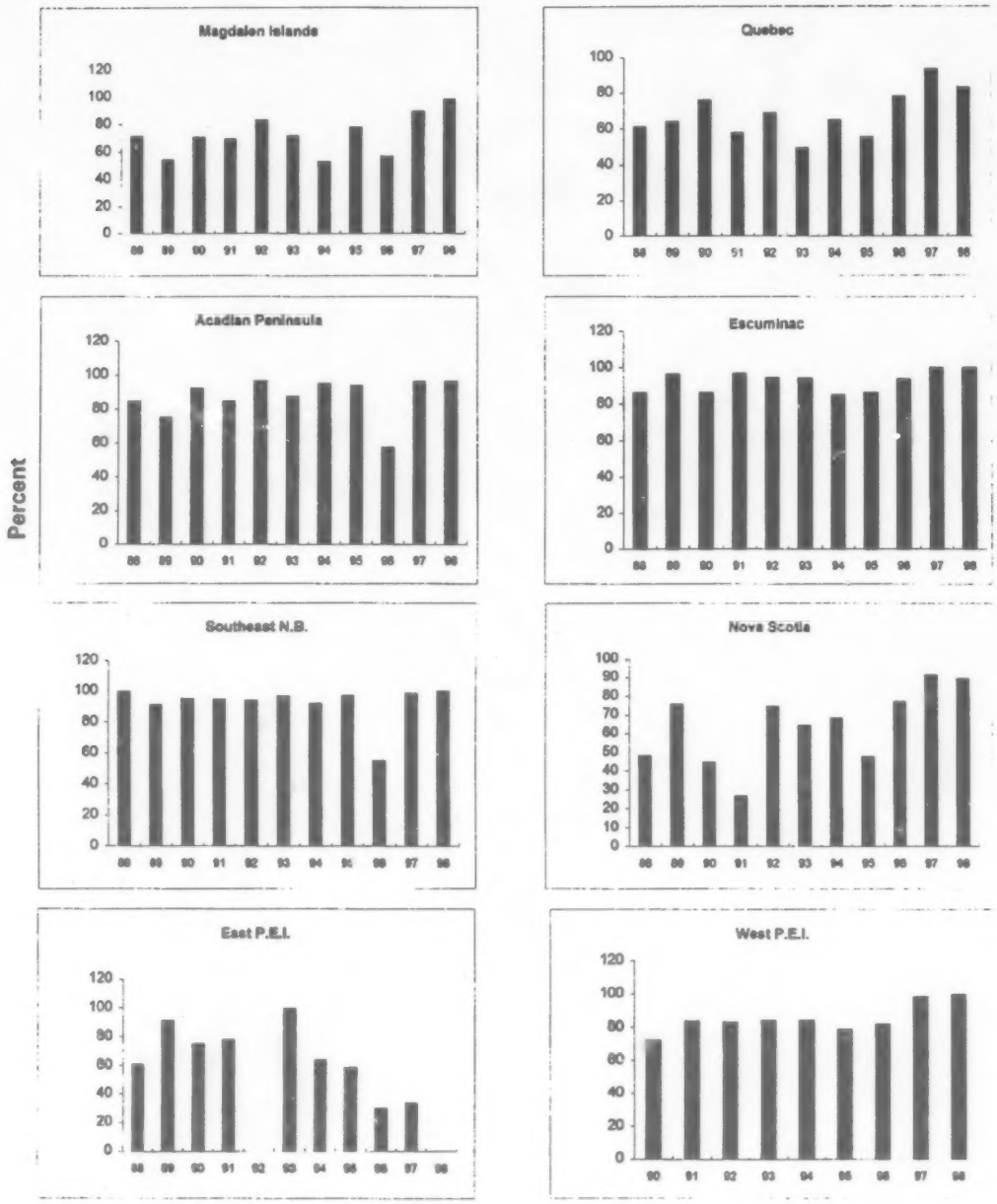


Fig. 9. Percent of nets fished that are between 2 1/4" and 2 1/2" mesh in the 4T spring fishery.

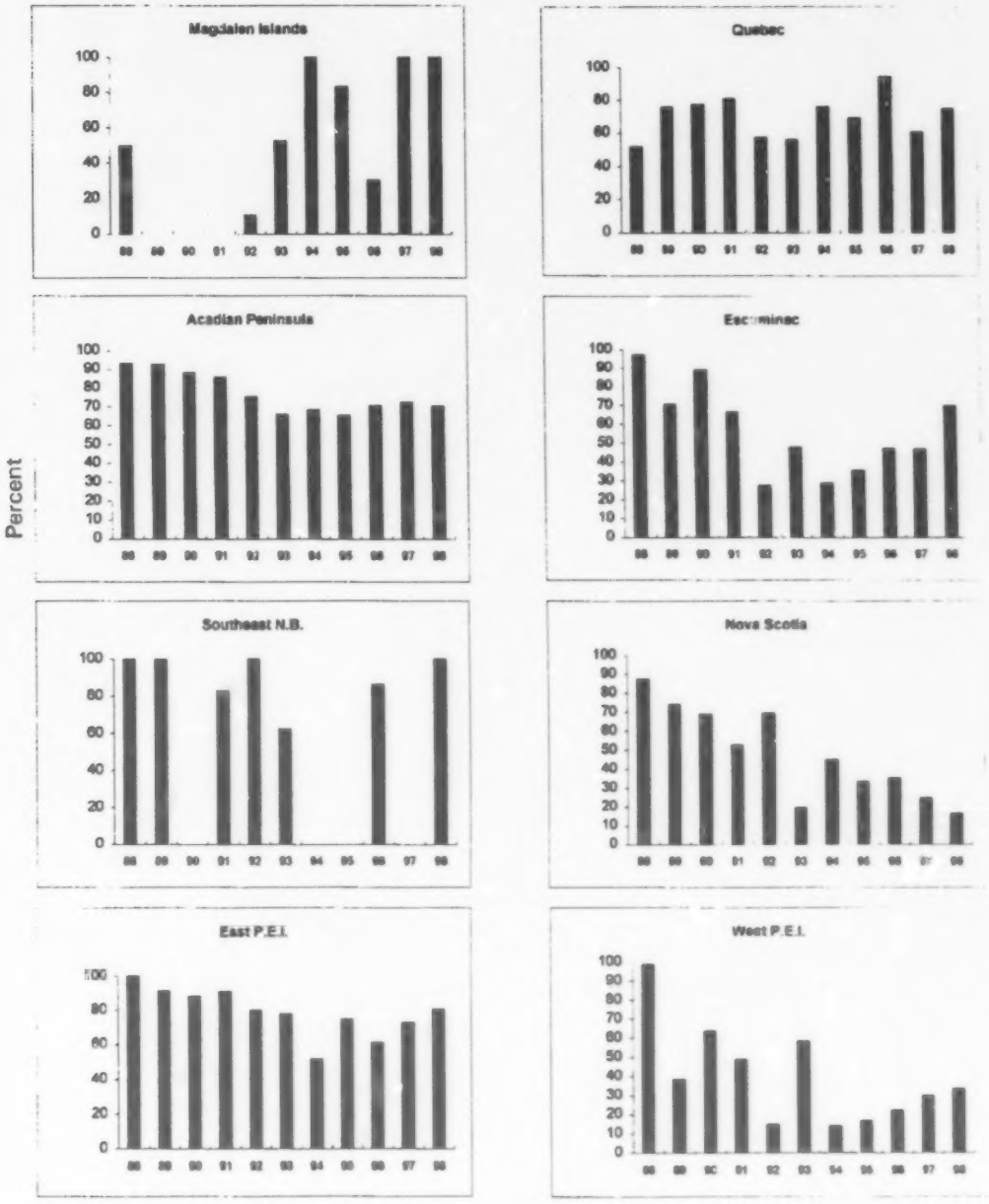


Fig. 10. Percent of nets fished that are 2 5/8" mesh in the 4T fall fishery.

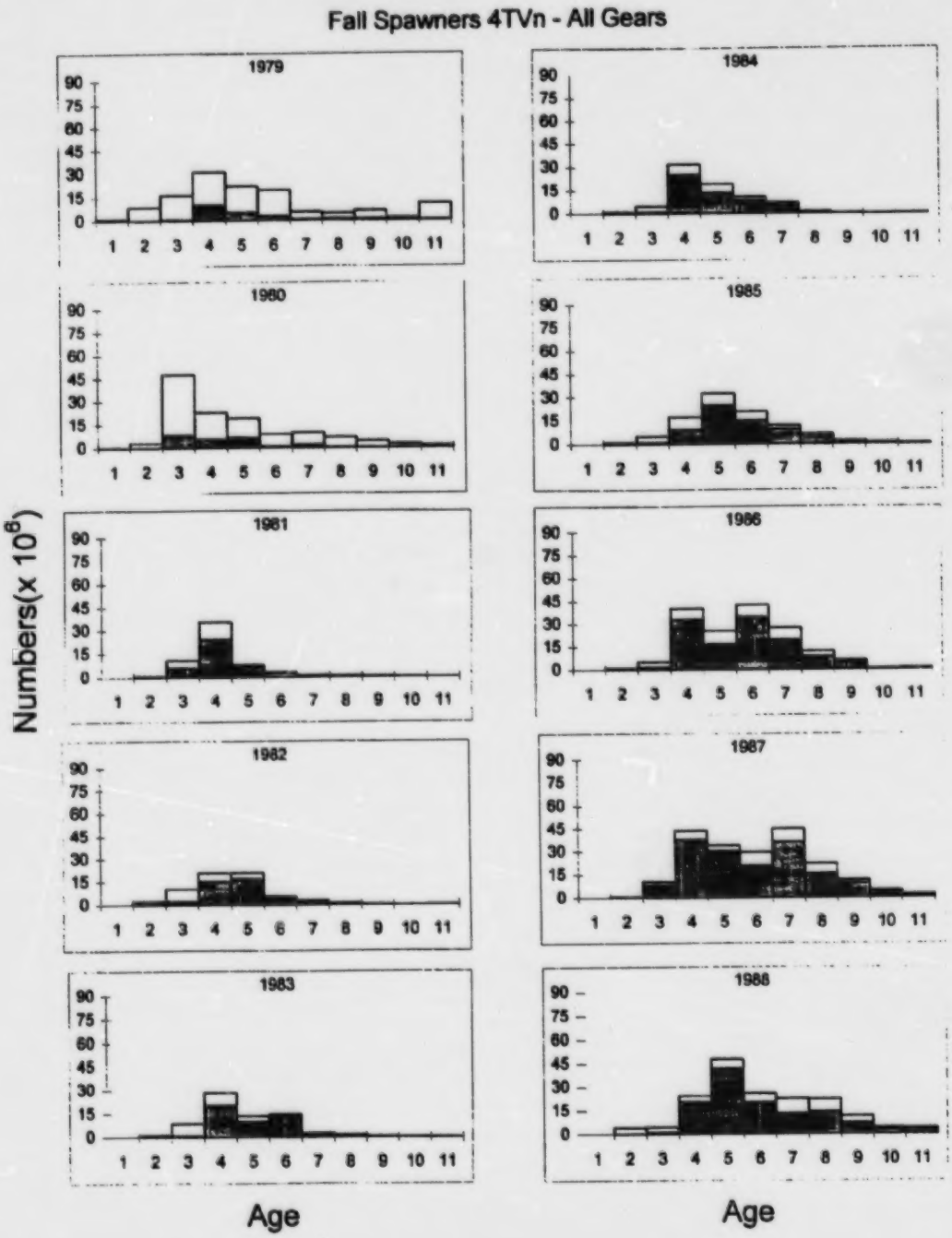


Fig. 11. Fall spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

F2

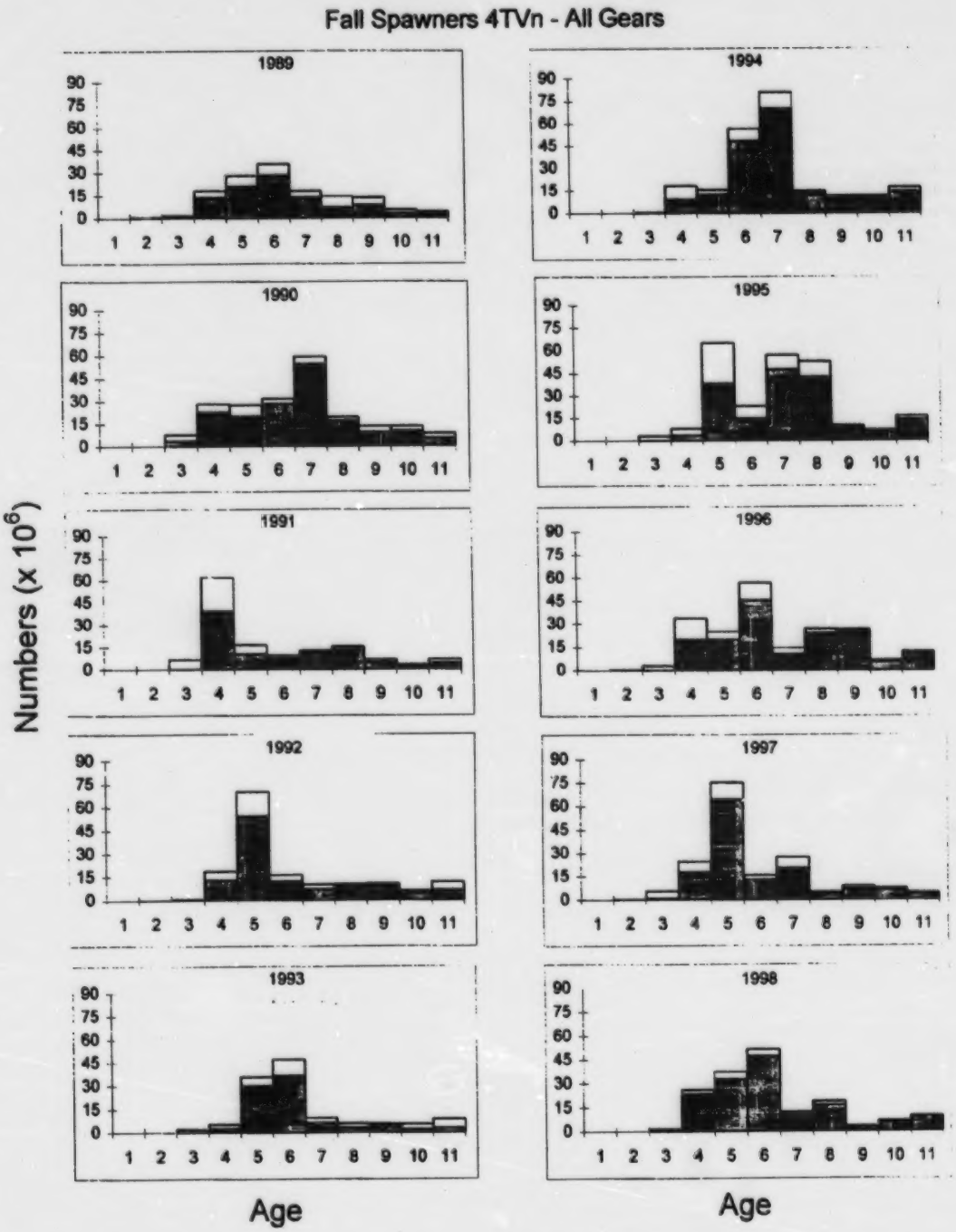


Fig. 11. (continued) Fall spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

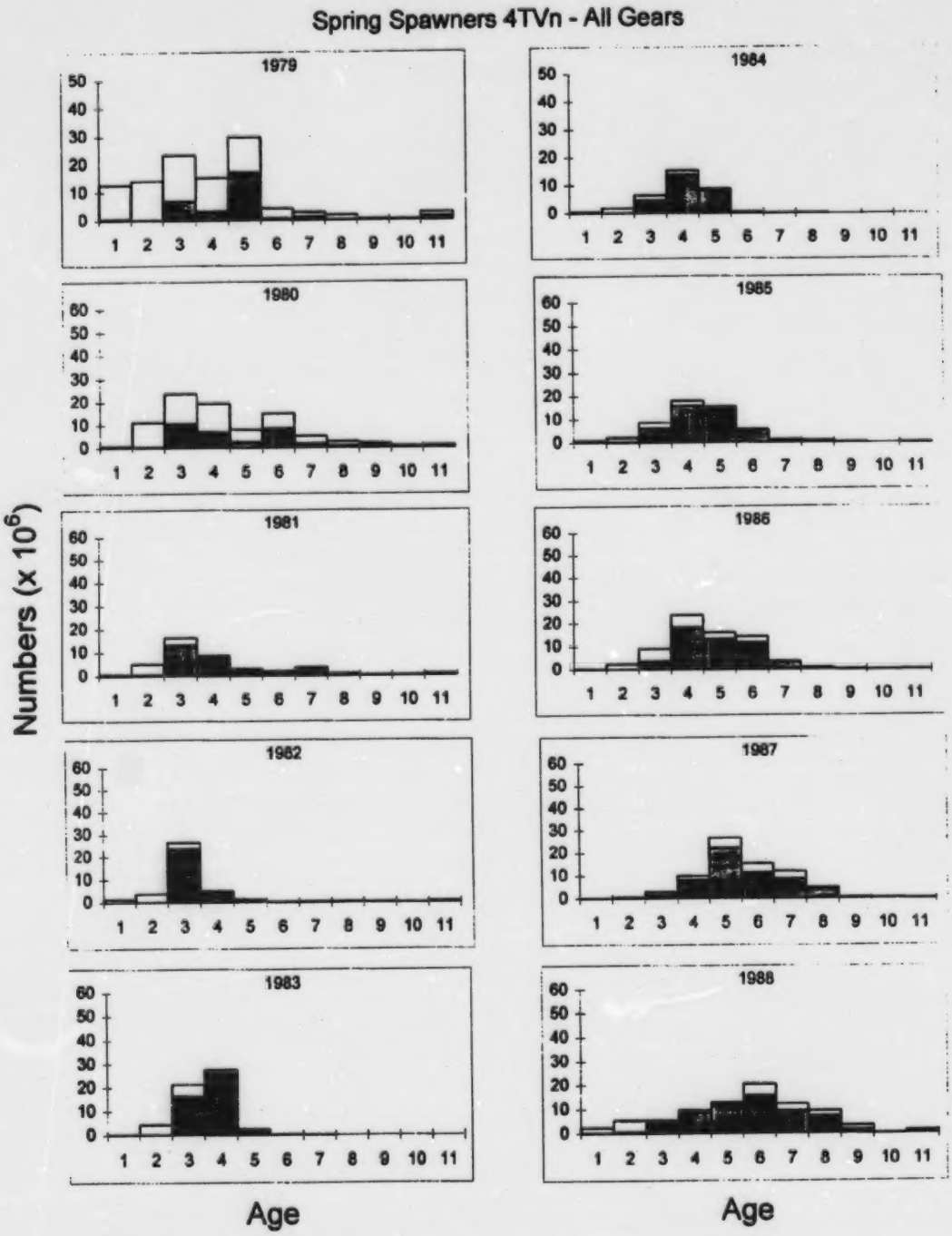


Fig. 12. Spring spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

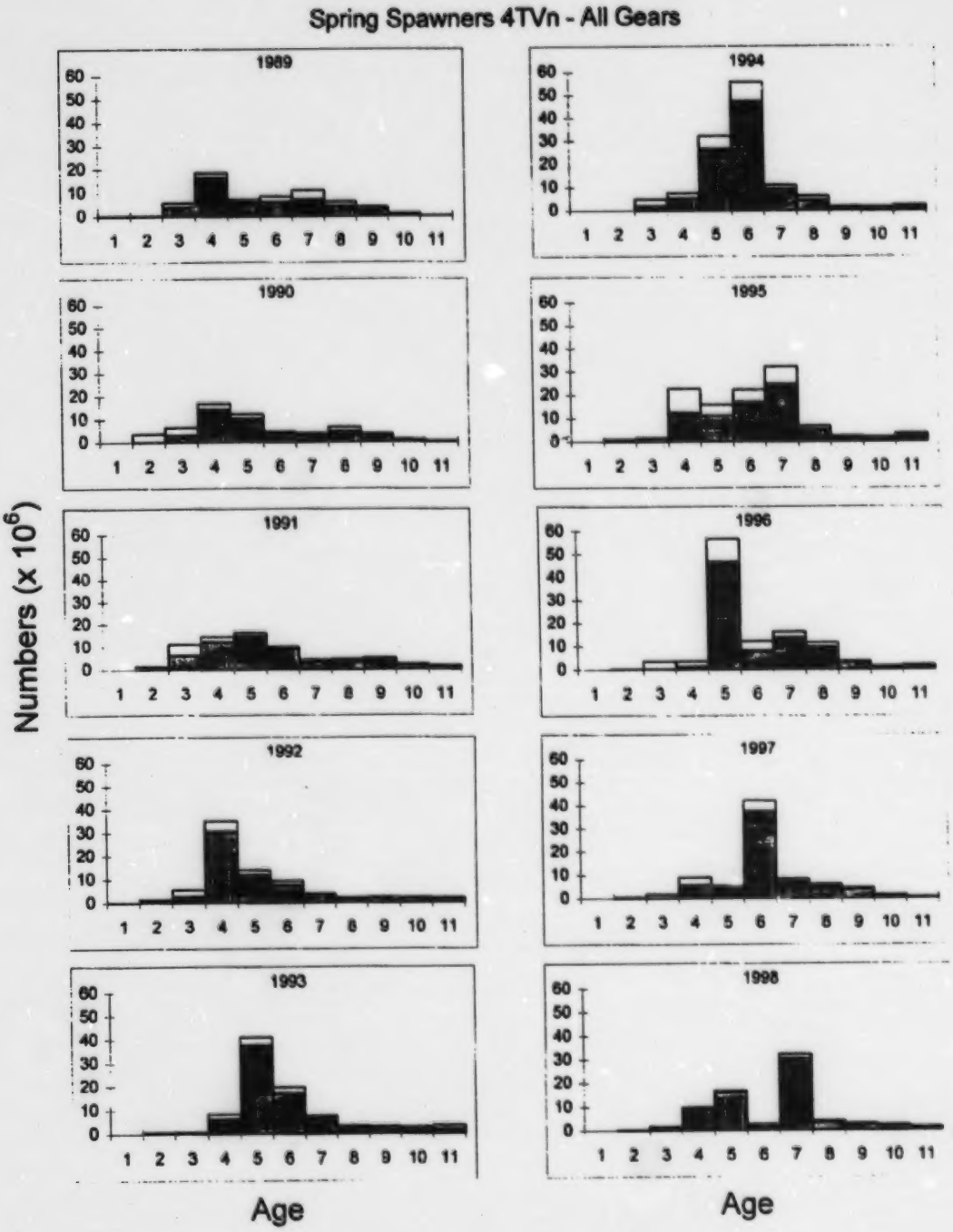


Fig. 12. (continued) Spring spawners catch-at-age all gears. Open bars are mobile gear catches, closed bars are fixed gear catches.

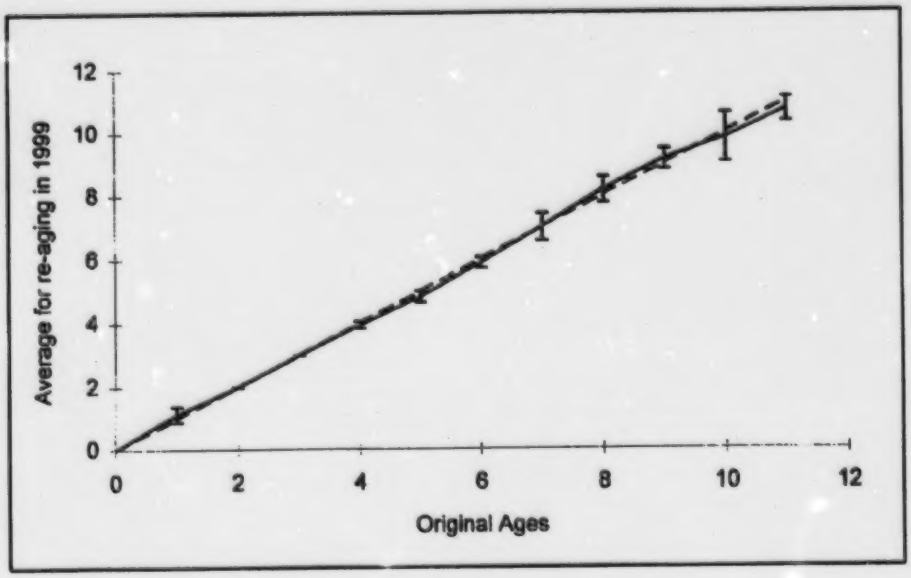


Fig. 13. Age bias plot.

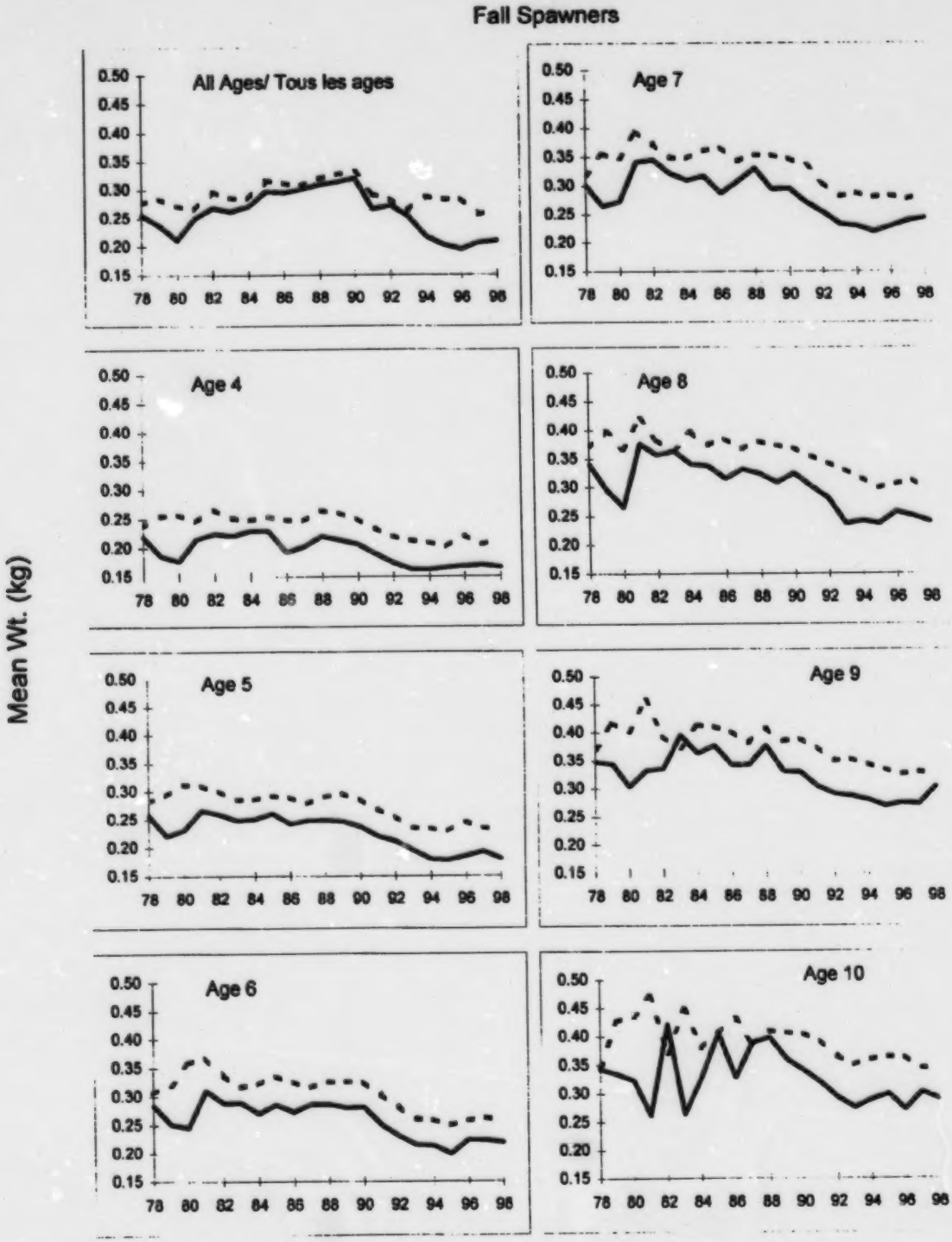


Fig. 14. Fall Spawners mean weight-at-age for all gears and for fixed and mobile gears, ages 4-10. Dotted line is fixed gear and solid line is mobile gear. Weight is in kilograms.

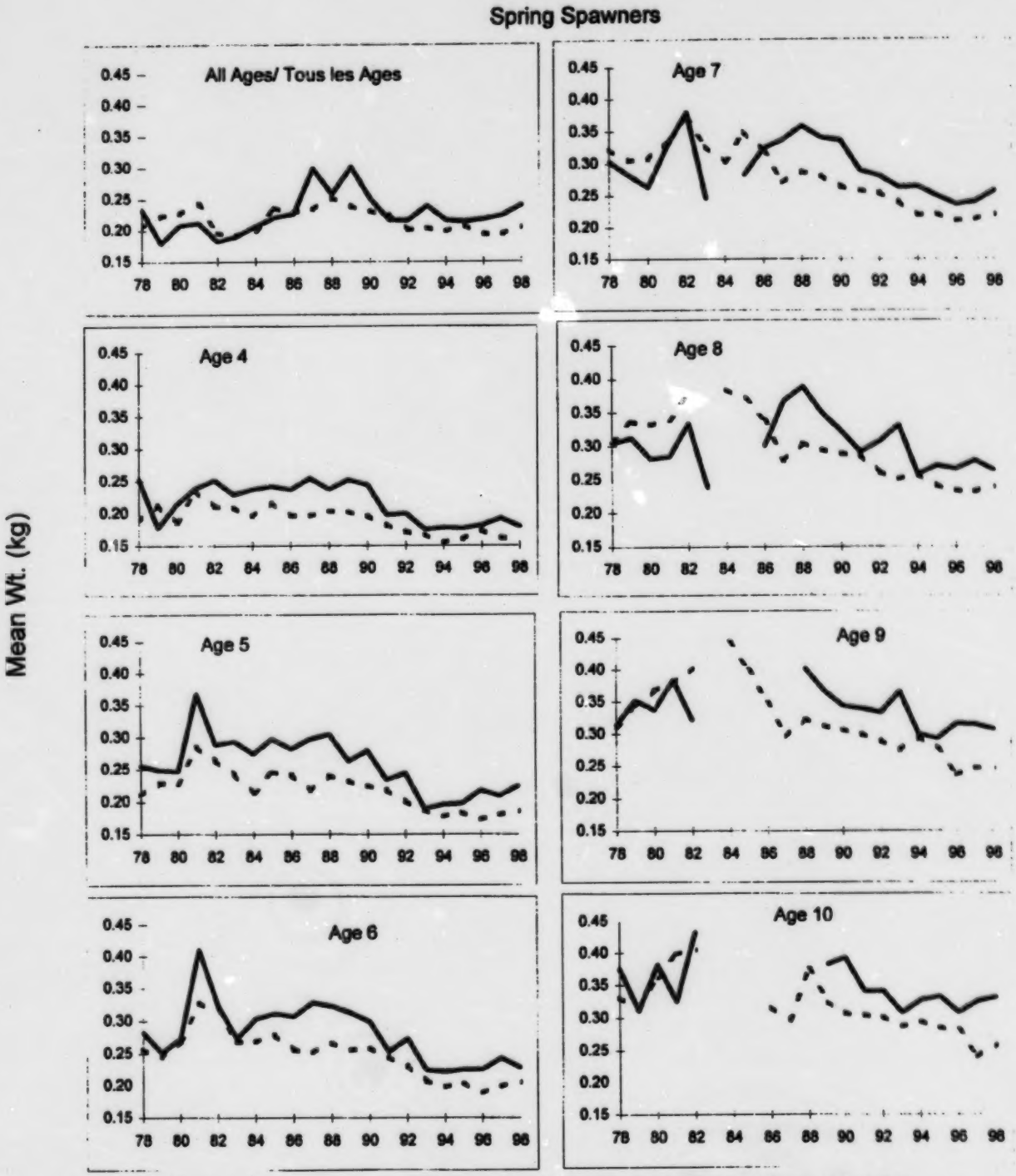


Fig. 15. Spring Spawners mean weight-at-age for all gears and for fixed and mobile gears,ages 4-10. Dotted line is fixed gear and solid line is mobile gear. Weight is in kg.

Spring Spawners - Escuminac:SENB

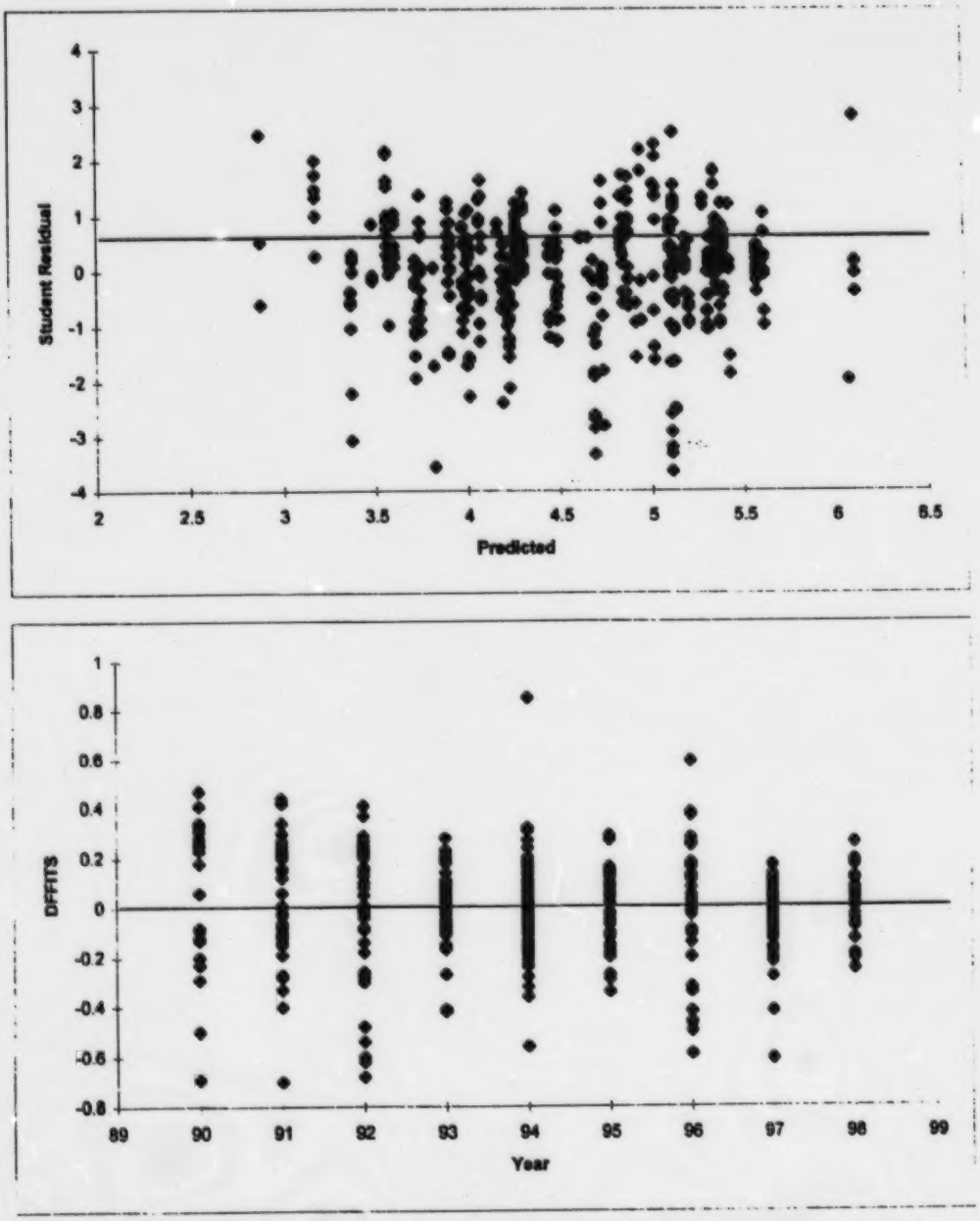


Fig. 16. Residuals and DFFITS plots from multiplicative analysis of Escuminac and southeast New Brunswick catch rates.

Spring Spawner - Escuminac:SENB

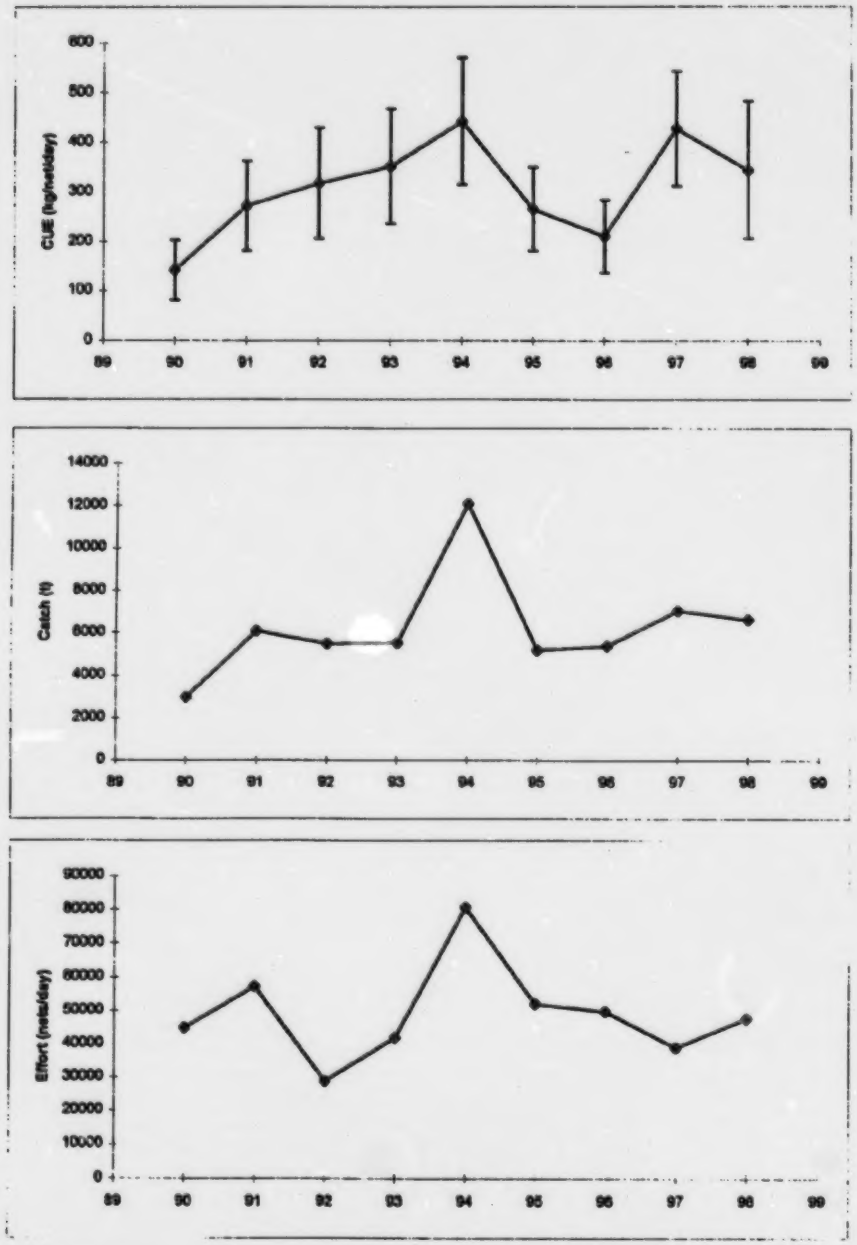


Fig. 17. Catch rates, catch, and effort from Escuminac and southeast New Brunswick catch rate analysis.

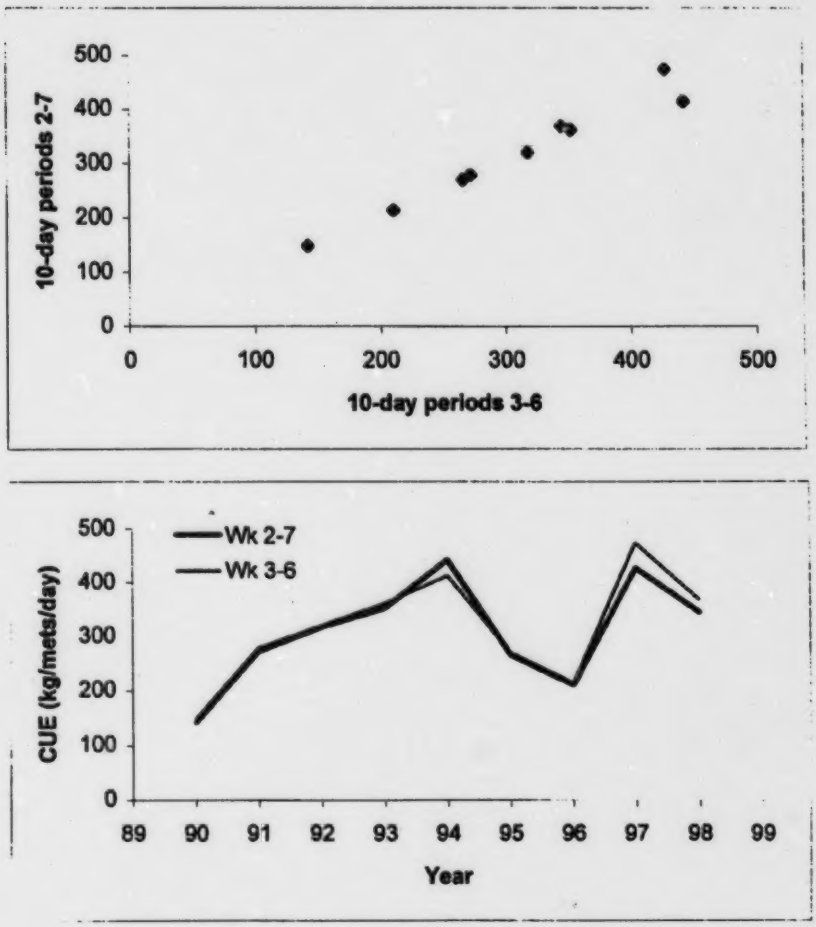


Fig. 18. Comparison of catch rates estimated using 10-day periods 2-7 and 10-day periods 3-6 from spring inshore herring fishery.

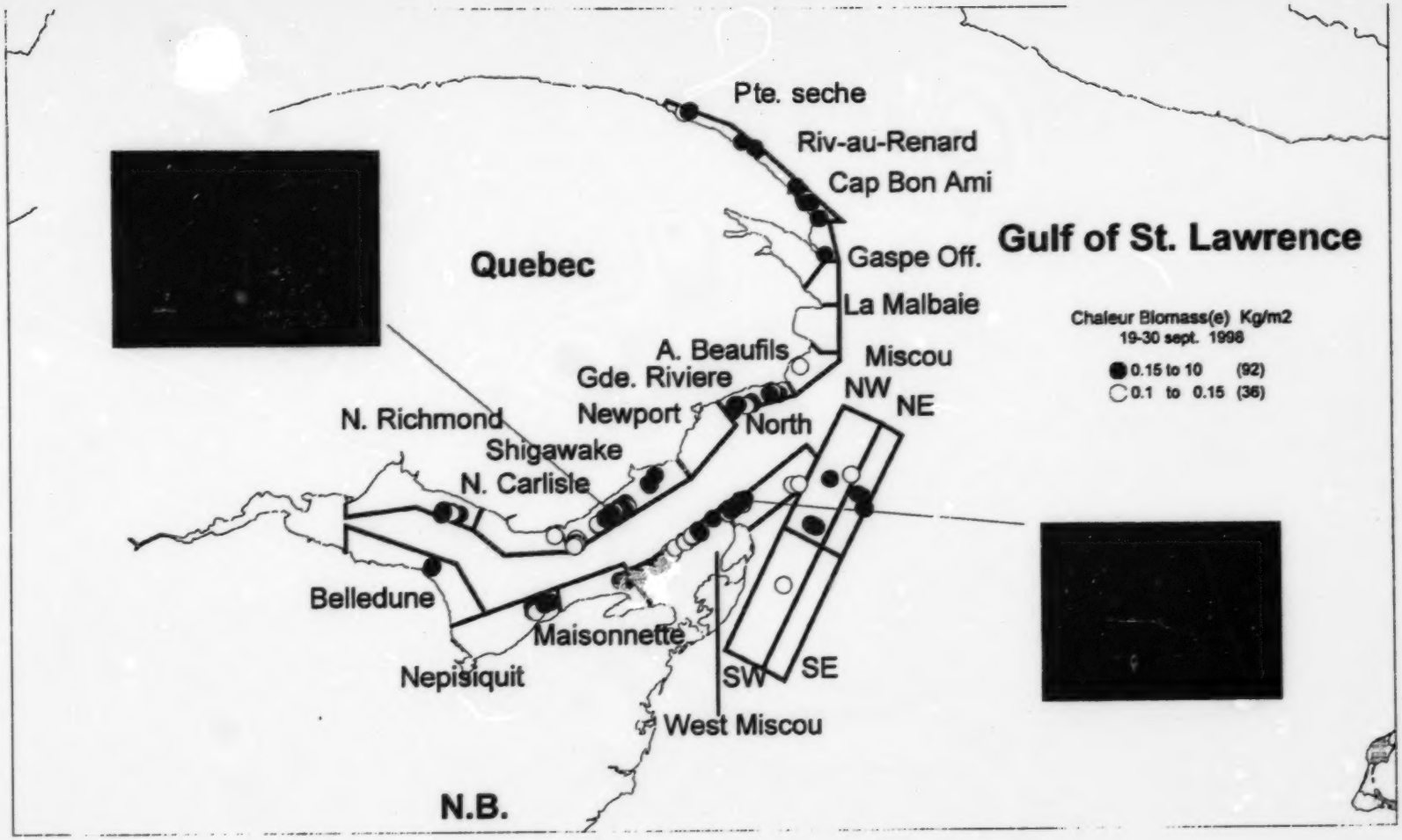


Fig. 19. Chaleur-Miscou area strata with relative biomass ranges detected between Sept. 19 and Sept. 30, 1998.

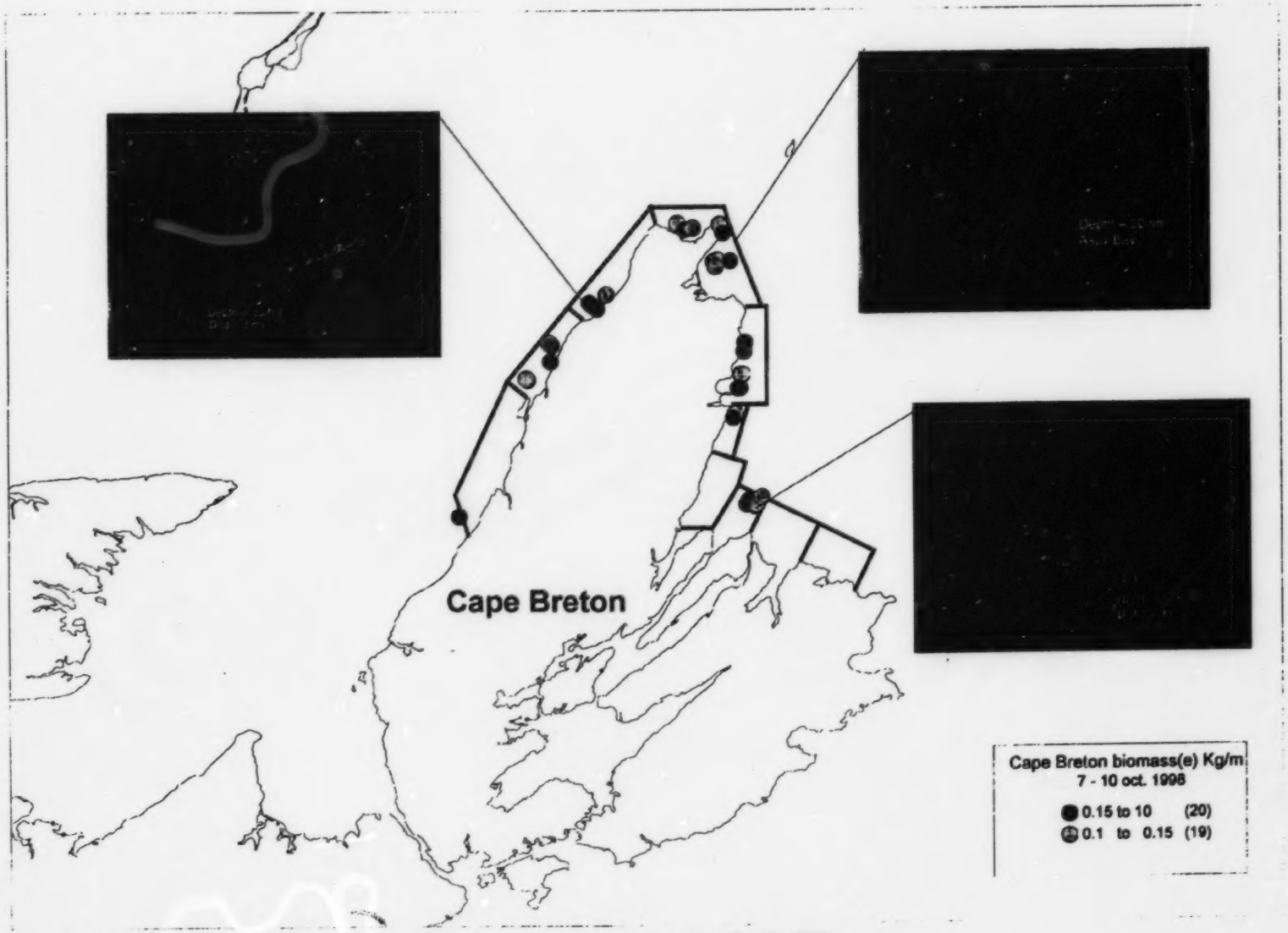


Fig. 20. Cape Breton area strata with relative biomass ranges detected between Oct. 7 and Oct 10, 1998.

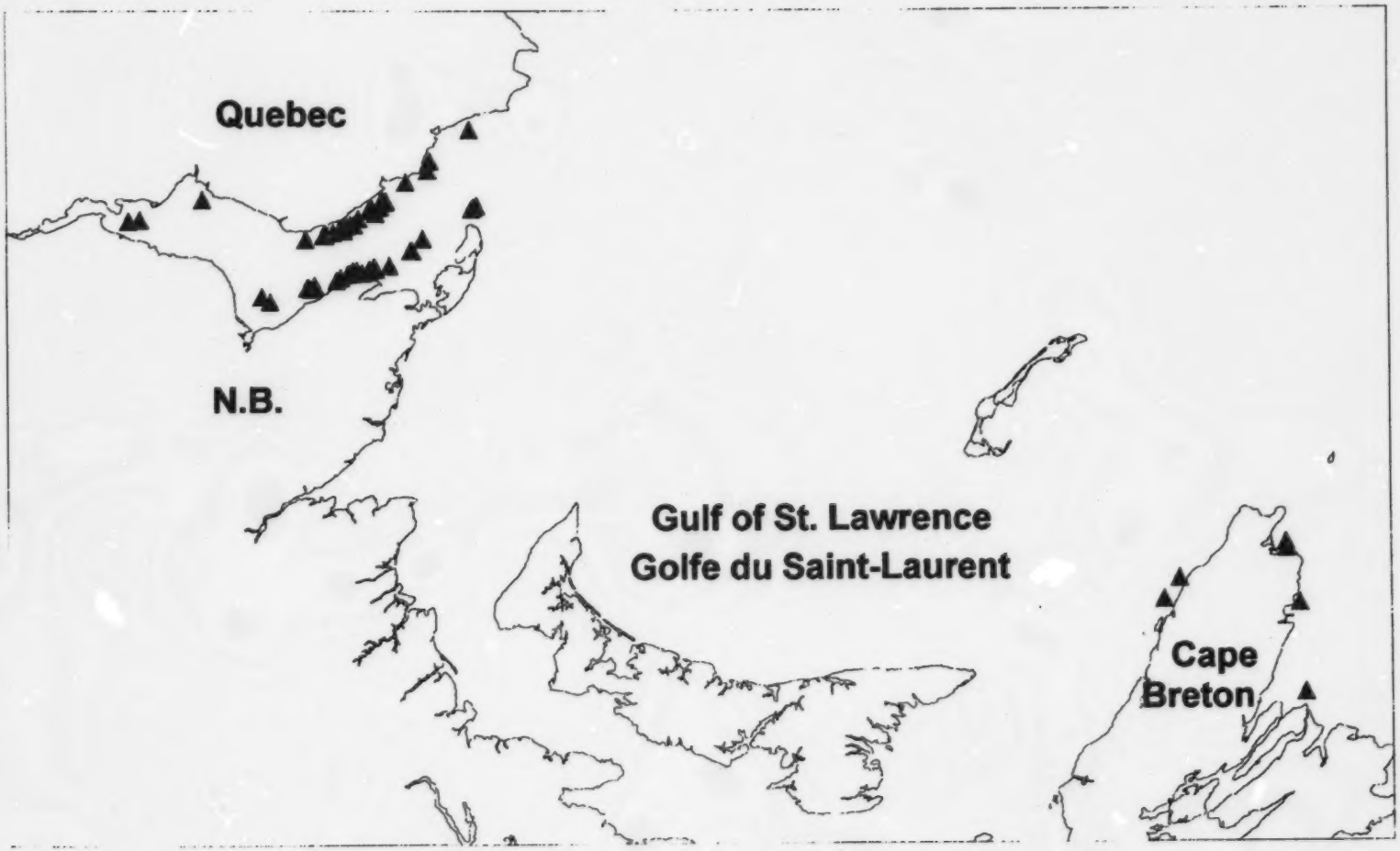


Fig. 21 Acoustic survey set locations, Sept. 19 to Oct. 10, 1998.

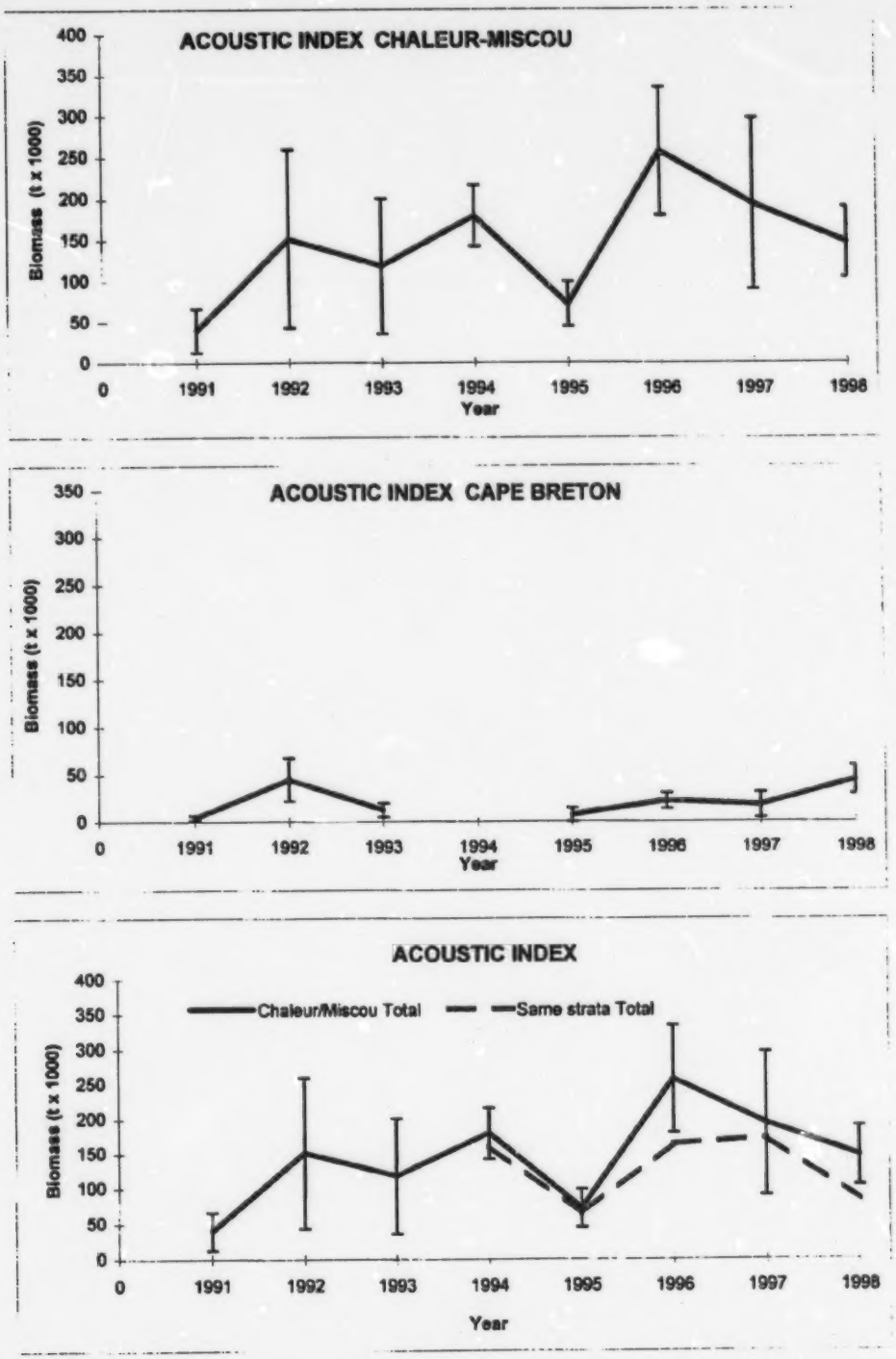


Fig. 22. Biomass index, combined spring and fall spawners, from acoustic survey of all strata from Chaleur-Miscou (top), all strata from Cape Breton (middle), and all Chaleur - Miscou strata compared to strata consistently surveyed in each year (bottom).

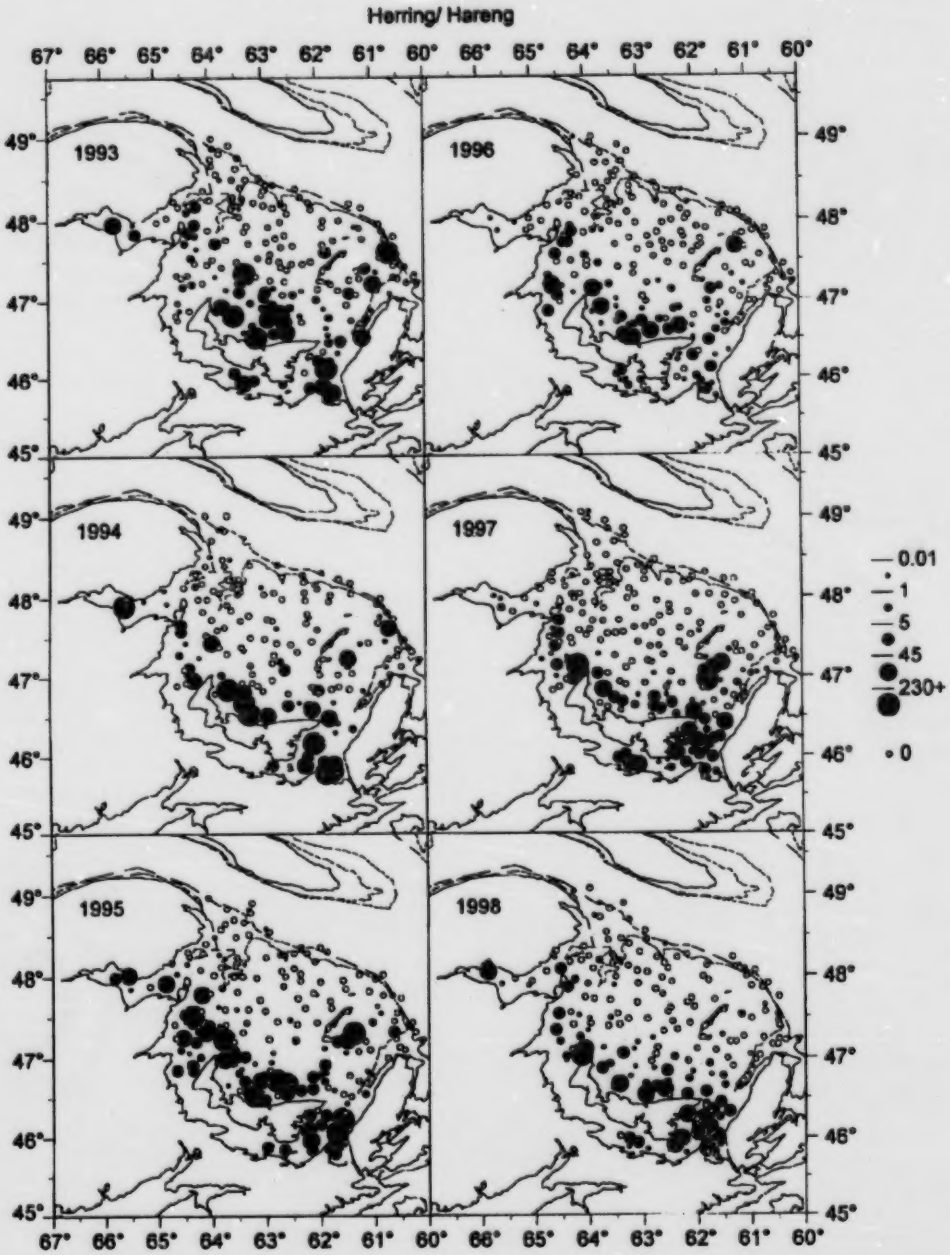
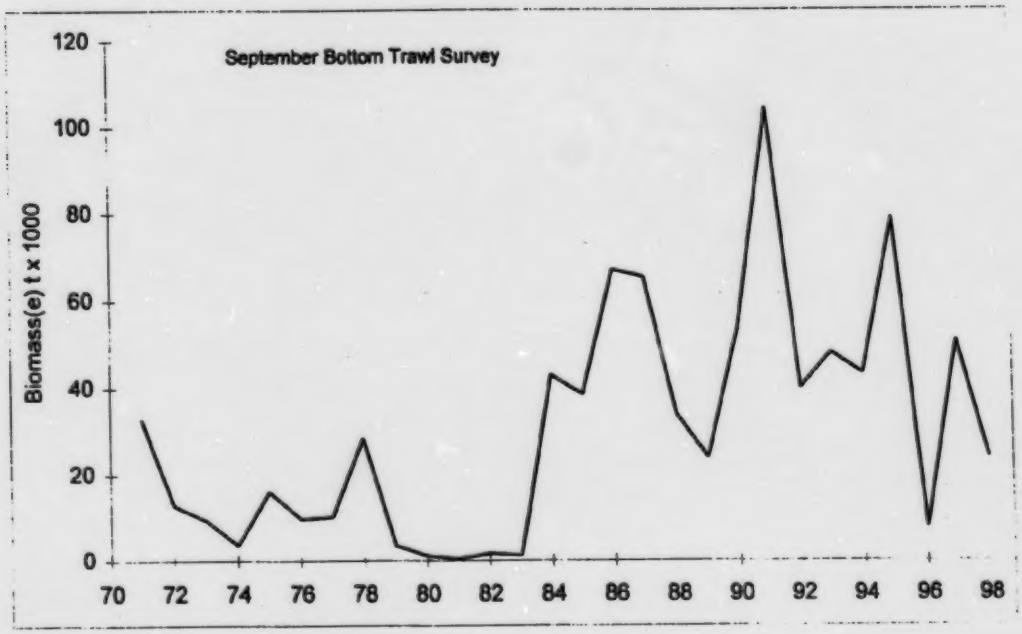


Fig. 23. Herring catches (kg/tow) in the southern Gulf of St. Lawrence September bottom trawl survey.



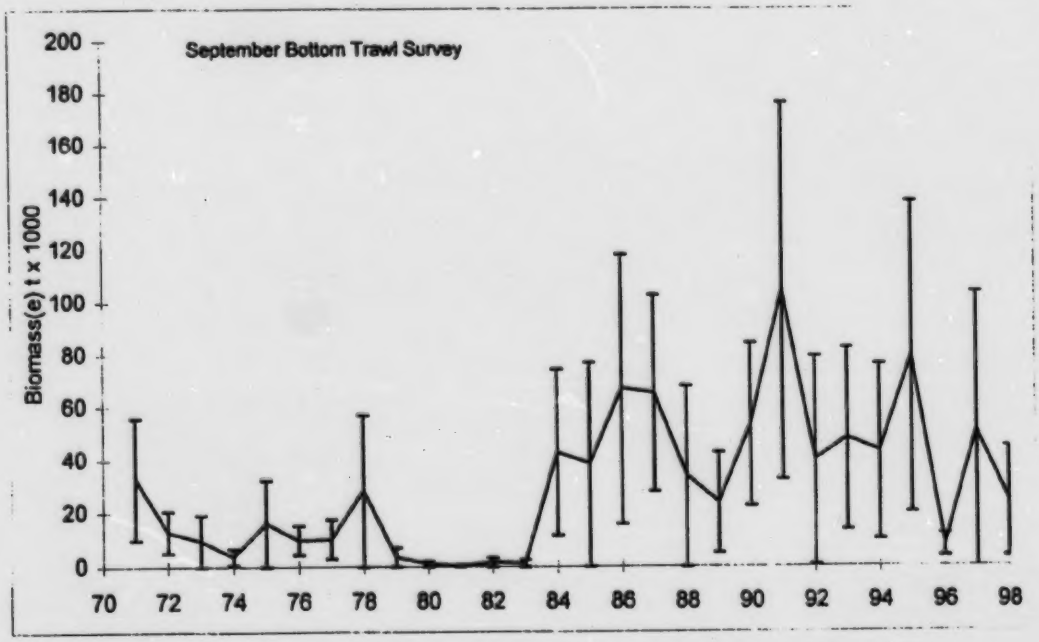


Fig. 24. Biomass trends (top) with confidence limits (+/- 2 S.E.) (bottom) for spring and fall spawning herring biomass estimates from September bottom trawl survey.

Spring Spawner
Residuals CUE Index (F-OLD)

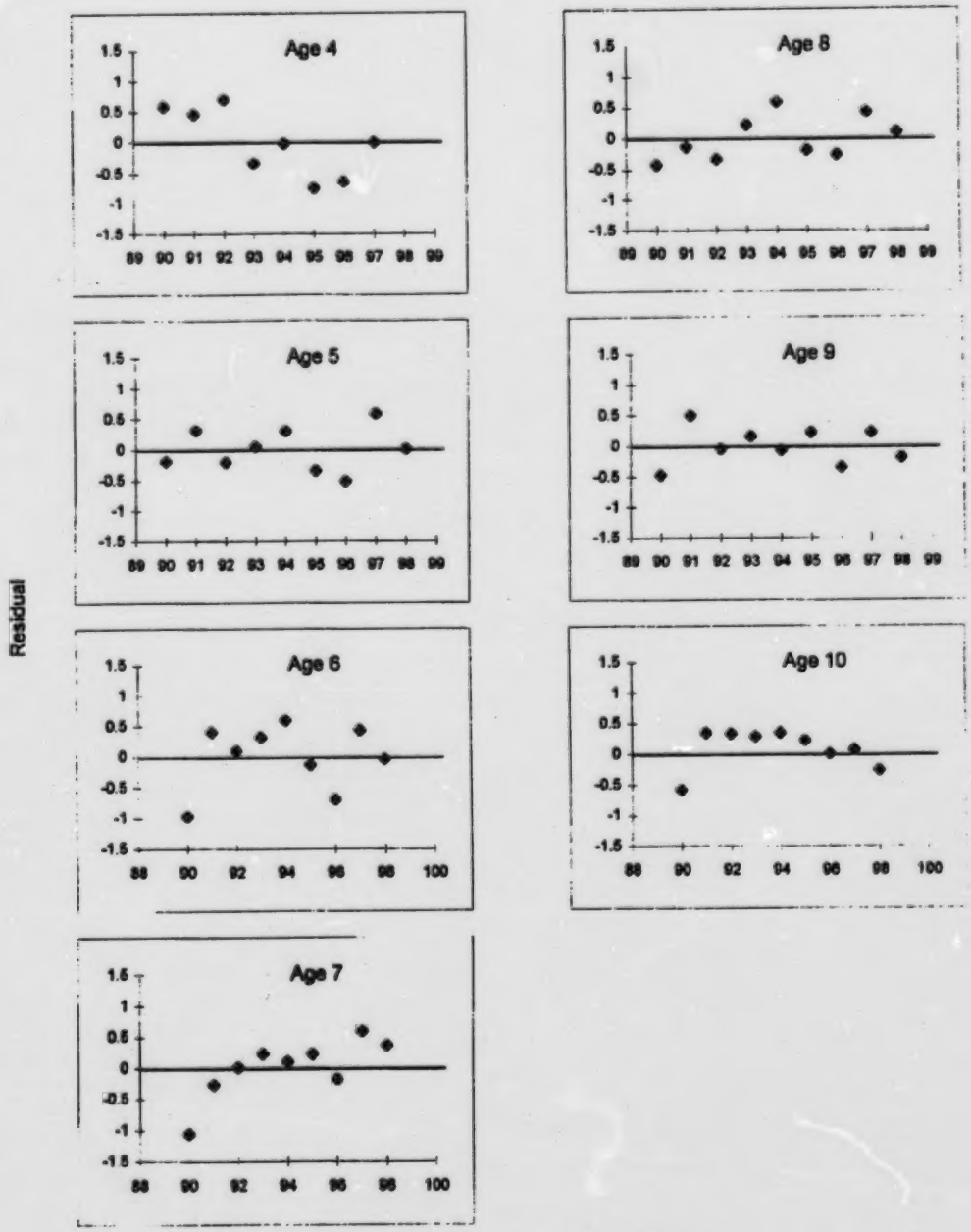


Fig. 25. Residuals by age from ADPAT-VPA using F-OLD formulation.

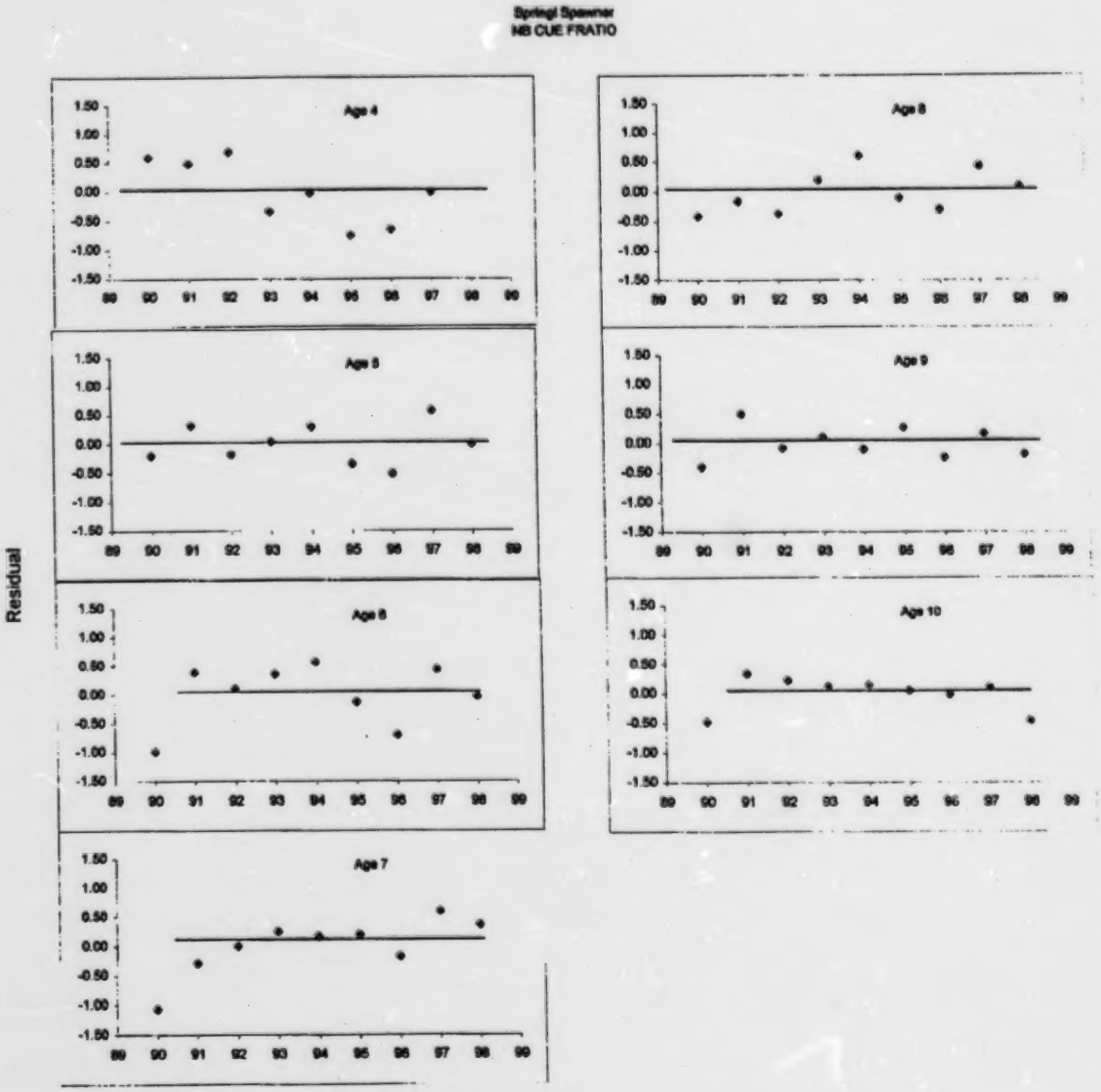


Fig. 26. Residuals by age from ADAPT-VPA using FRATIO formulation.

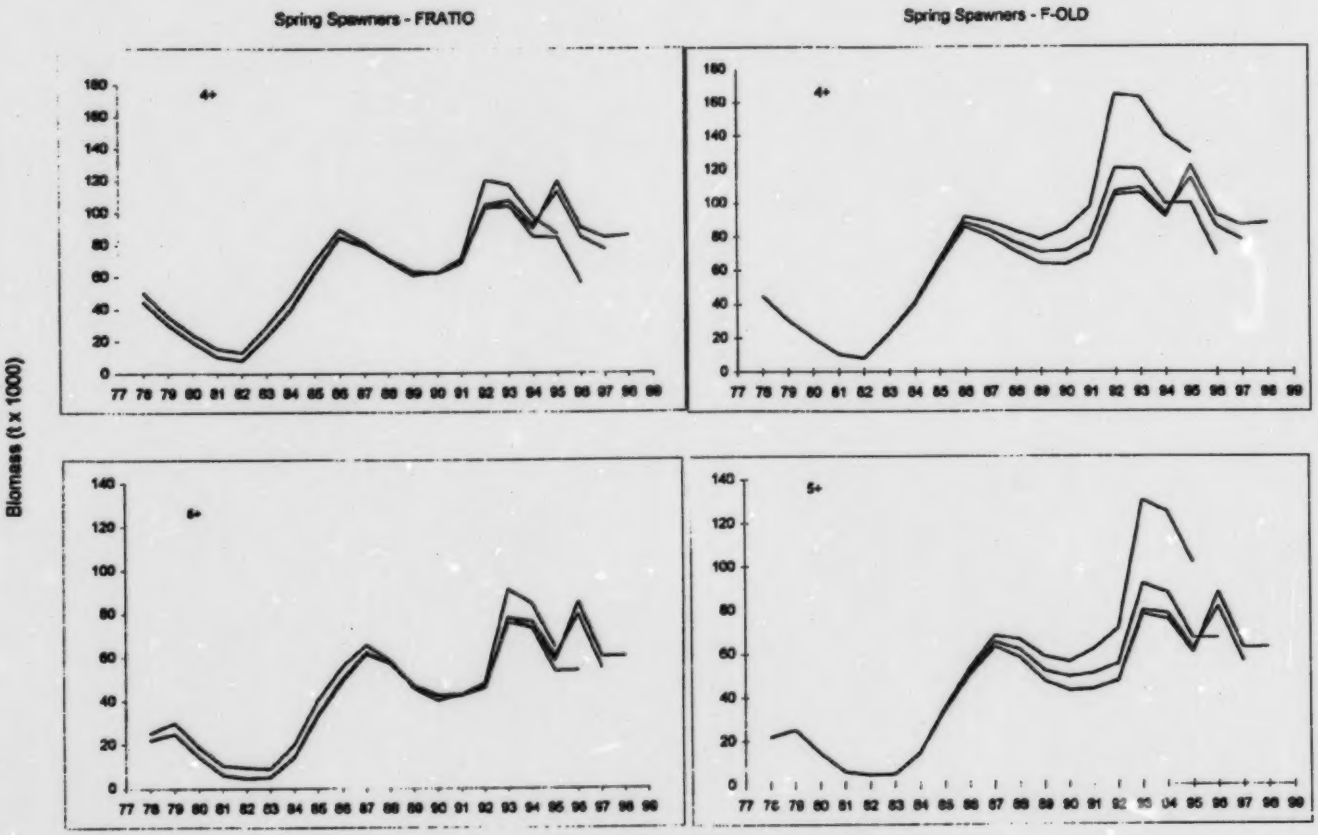


Fig. 27. Comparison of retrospective analysis for 4+ and 5+ biomass estimates using FRATIO and F-OLD ADAPT-VPA models.

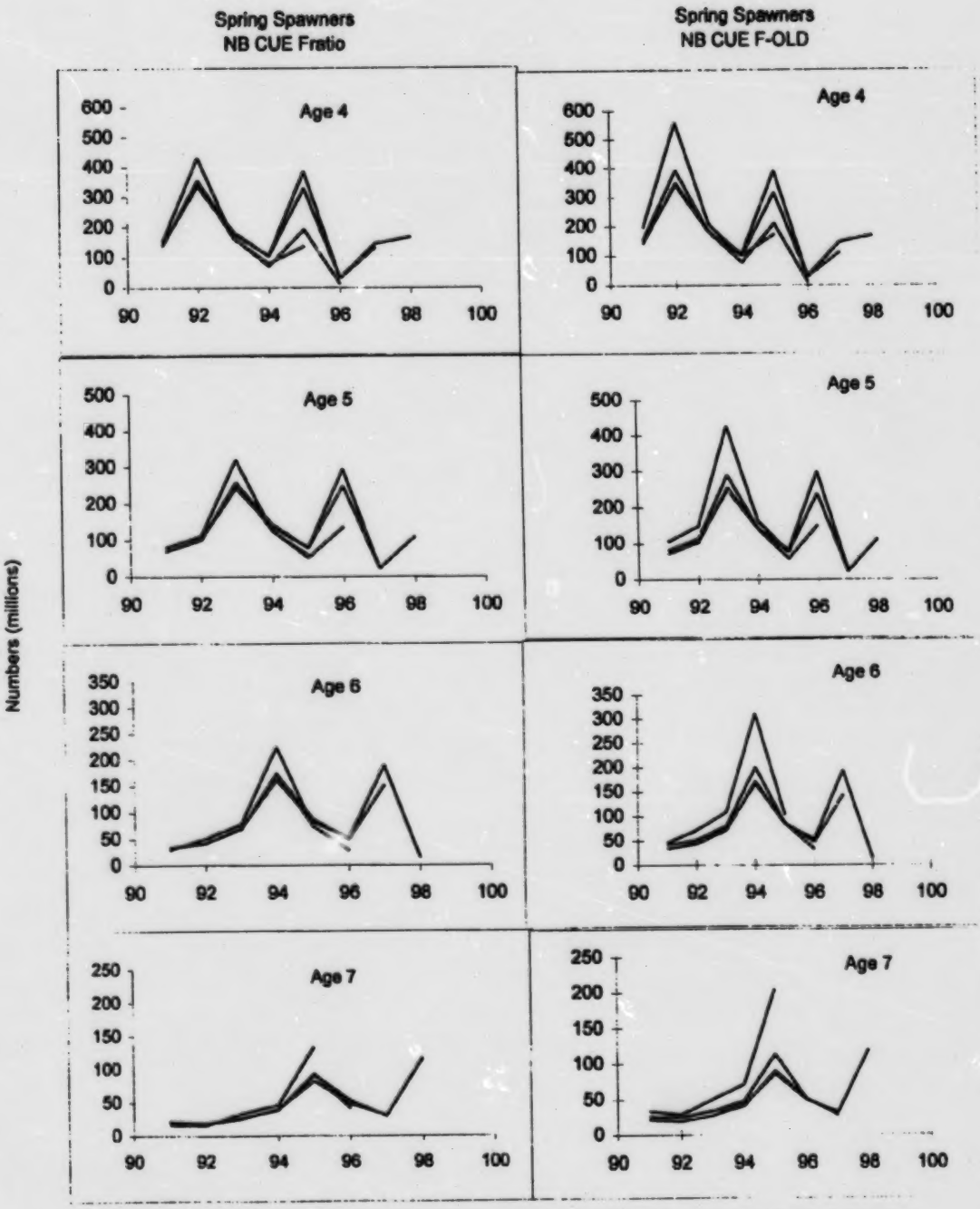


Fig. 28. Retrospective analysis by age for FRATIO and F-OLD spring spawner ADAPT-VPA models.

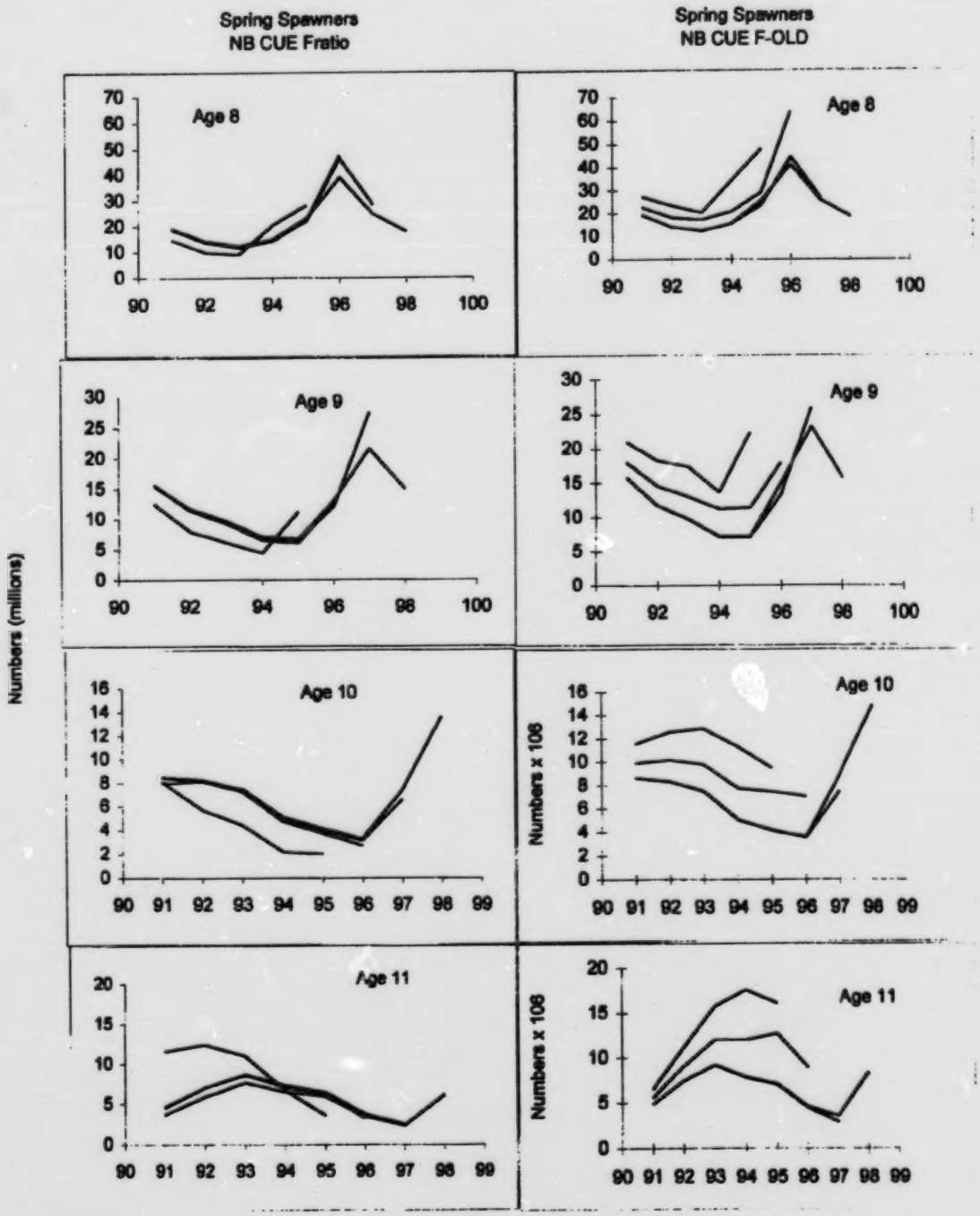

Spring Spawners
NB CUE Fratio
Spring Spawners
NB CUE F-OLD
Age 8
Age 9
Age 10
Age 11
Numbers (millions)
Numbers x 10⁶

Fig. 28. Cont.

Spring Spawners ADAPT Comparison

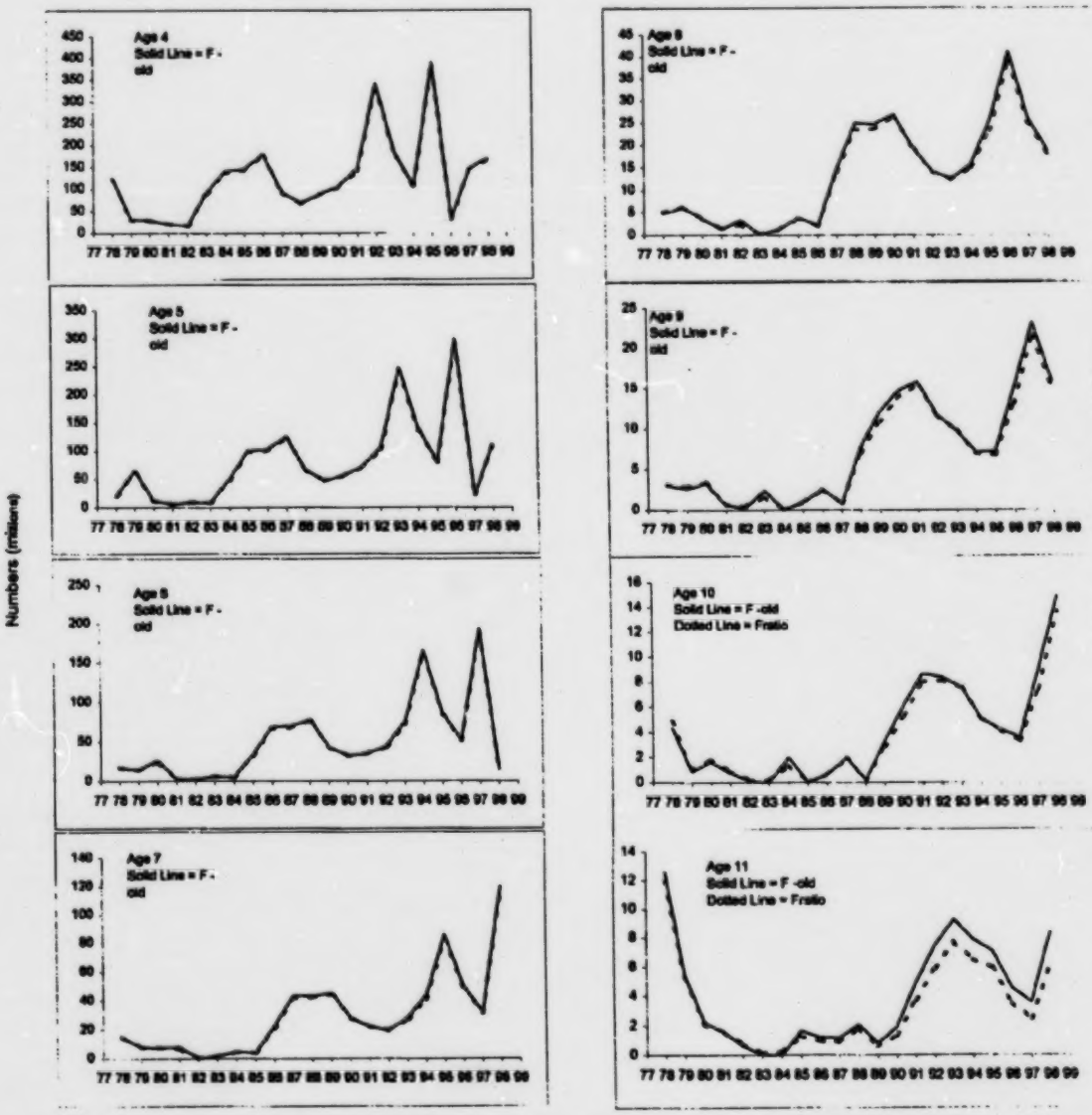


Fig:. 29. Comparison of population numbers estimated by FRATIO and F-OLD ADAPT-VPA models for spring spawners.

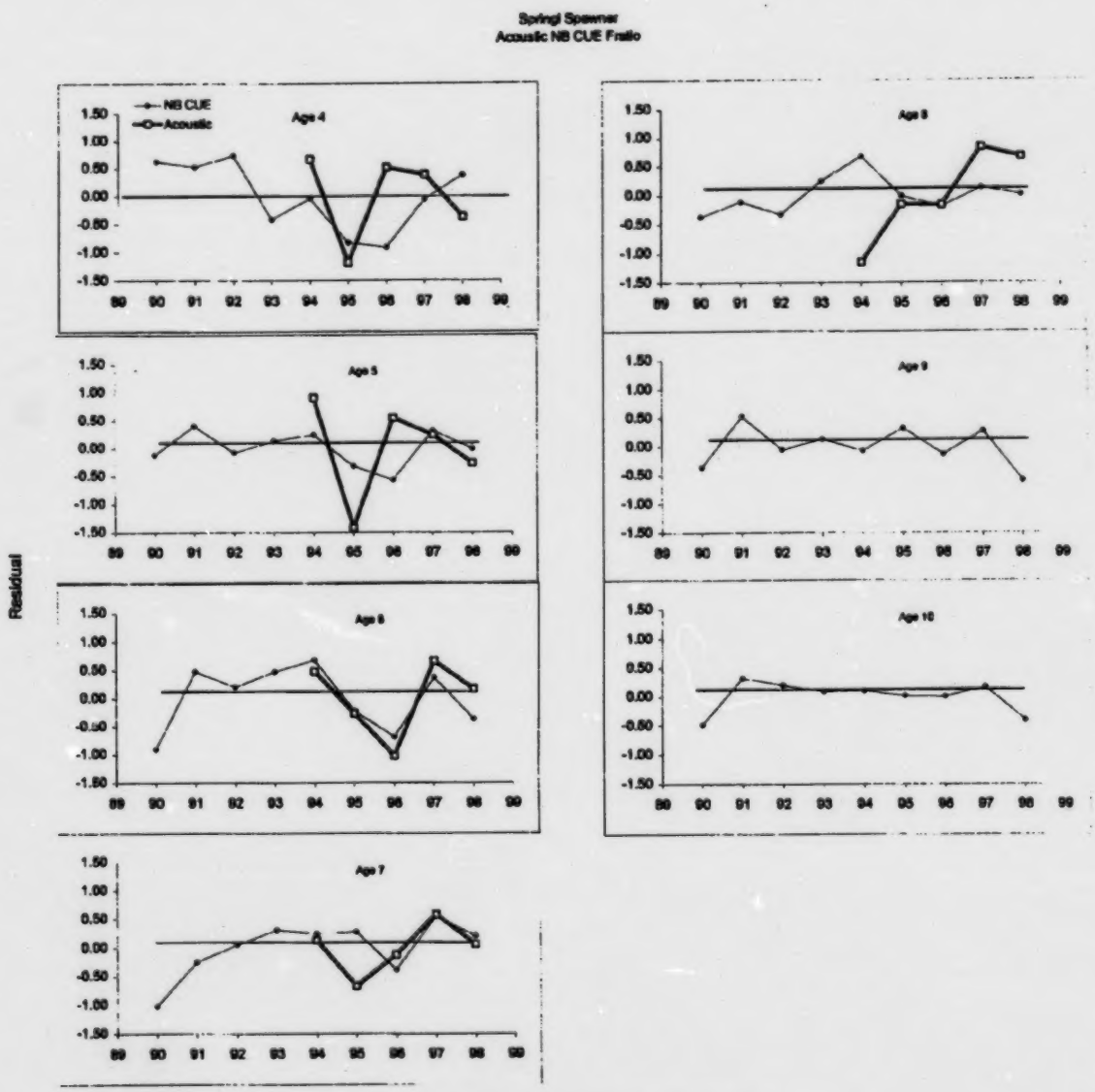


Fig. 30. Residuals by age for spring spawner ADAPT-VPA using acoustic and catch rate indices.

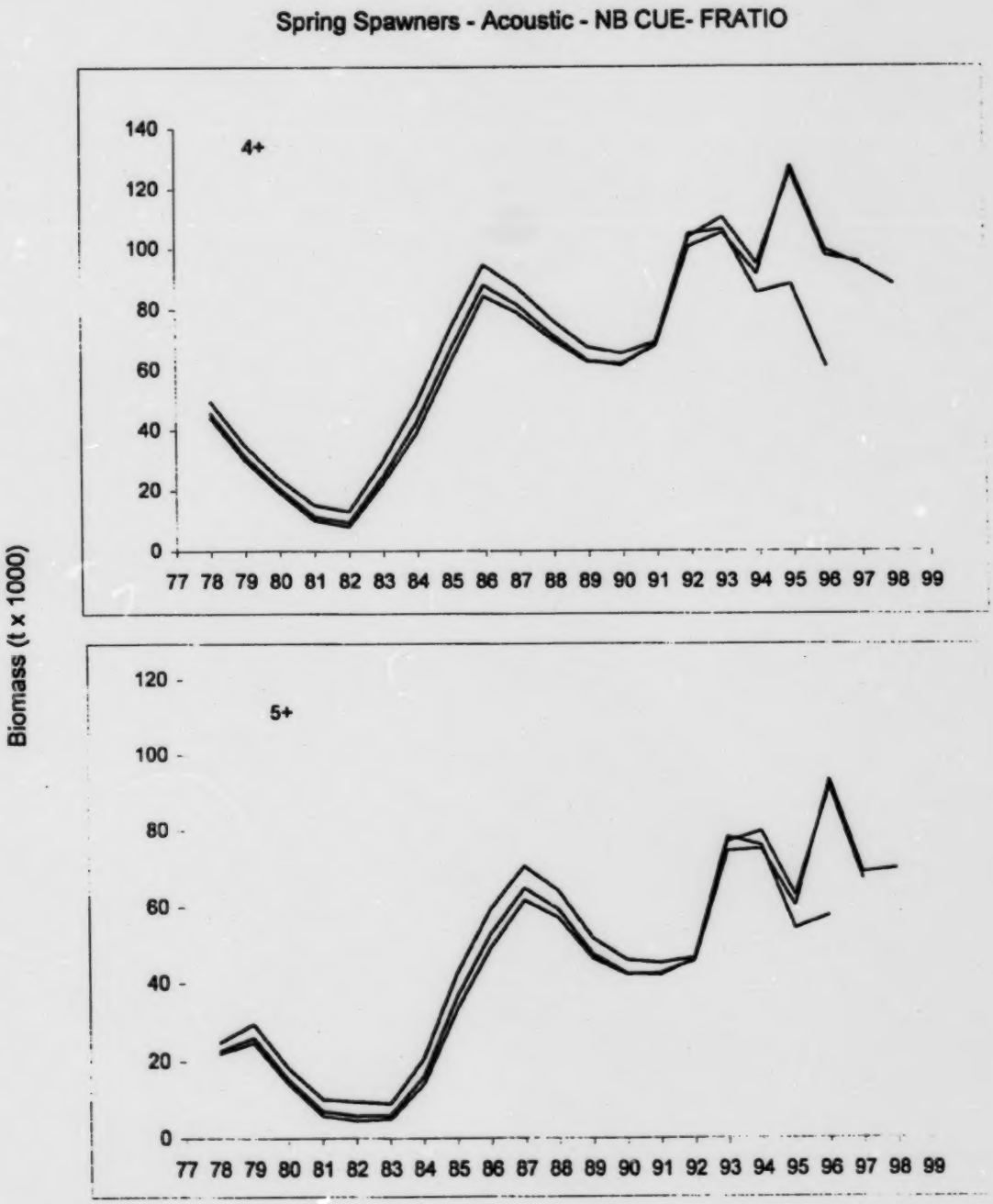


Fig. 31. Retrospective analysis of spring spawner ADAPT-VPA biomass estimates using acoustic and catch rate indices.

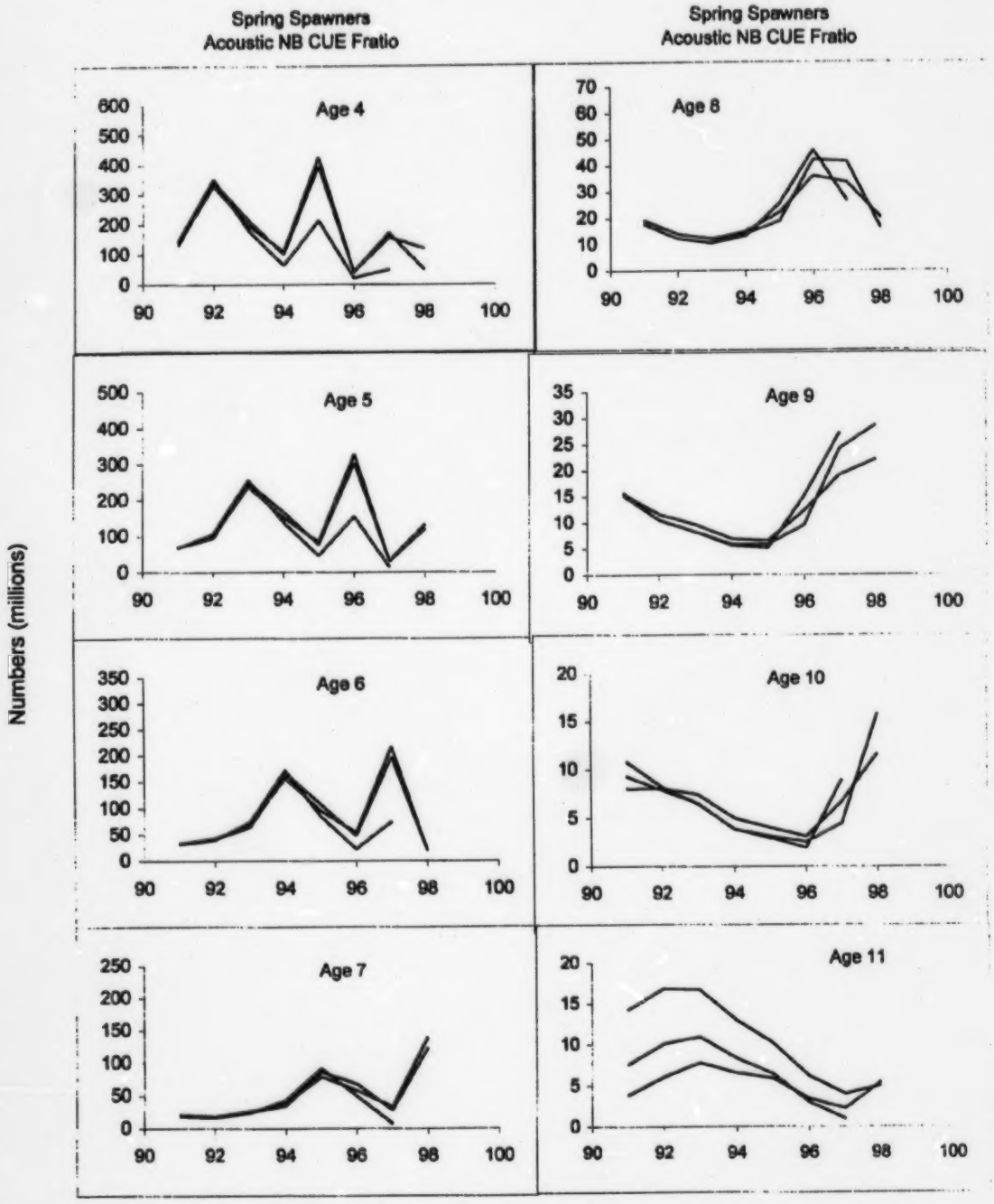


Fig. 32. Retrospective by age for spring spawner ADAPT-VPA using acoustic and catch rate indices.

Spring Spawners ADAPT Comparison
Acoustic - NB CUE Index

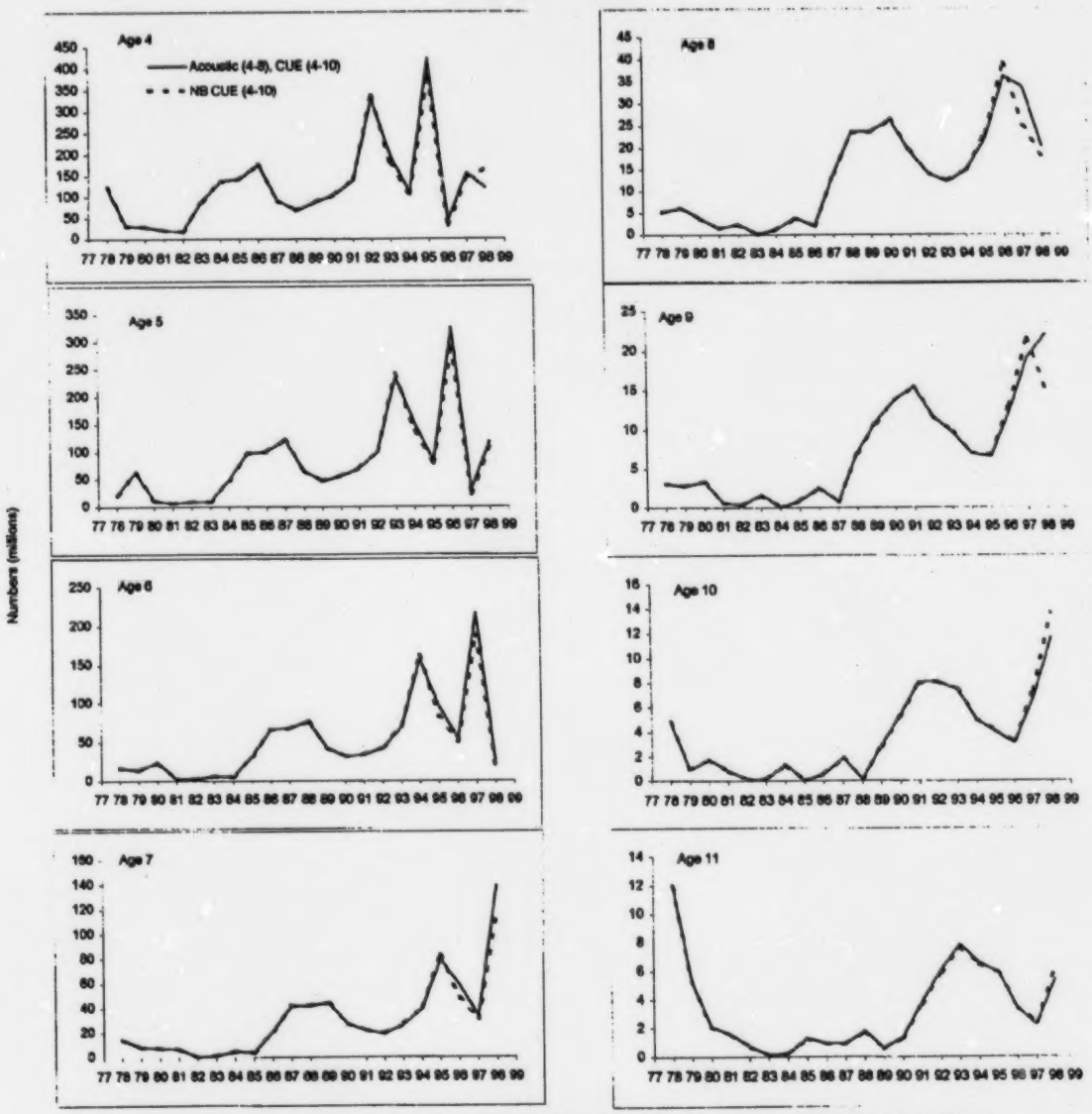


Fig. 33. Comparison of population estimates by number for spring spawner ADAPT-VPA using acoustic and catch rate indices together and catch rate indices alone.

Spring Spawners
Projection Comparisons

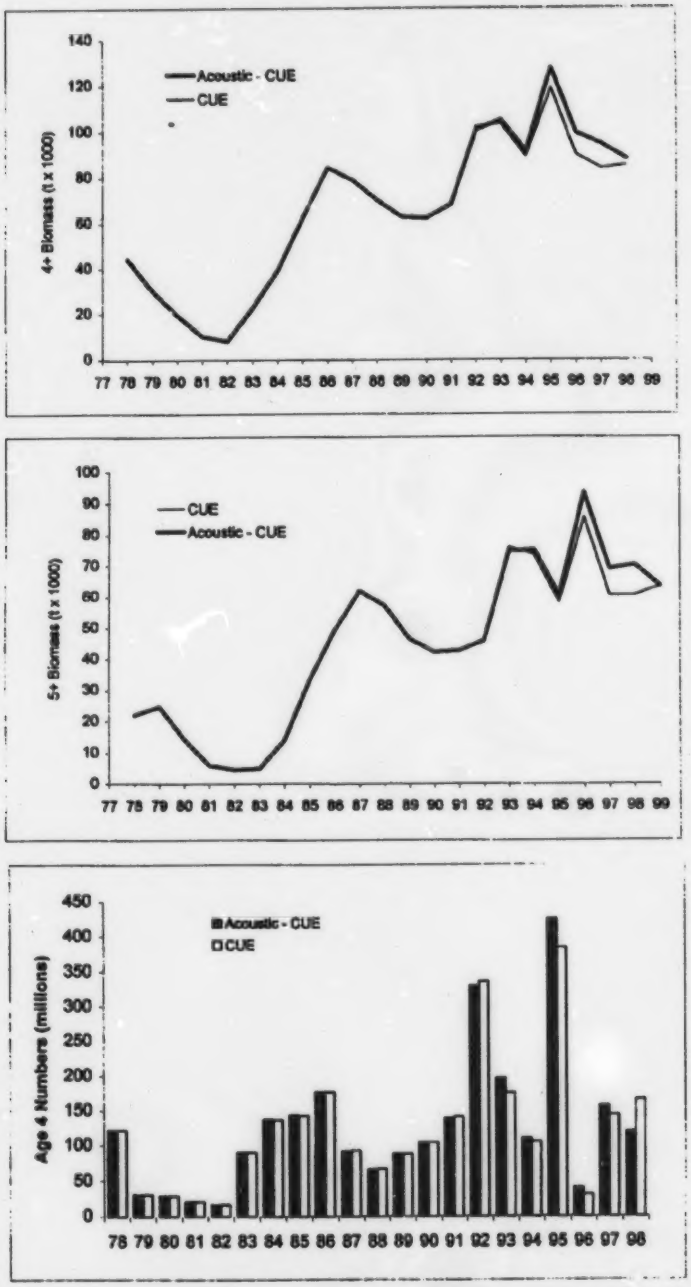


Fig. 34. Comparison of spring spawner ADAPT-VPA biomass and recruitment (age 4) estimates for FRATIO model using catch rates alone and catch rates combined with acoustic survey as calibration index.

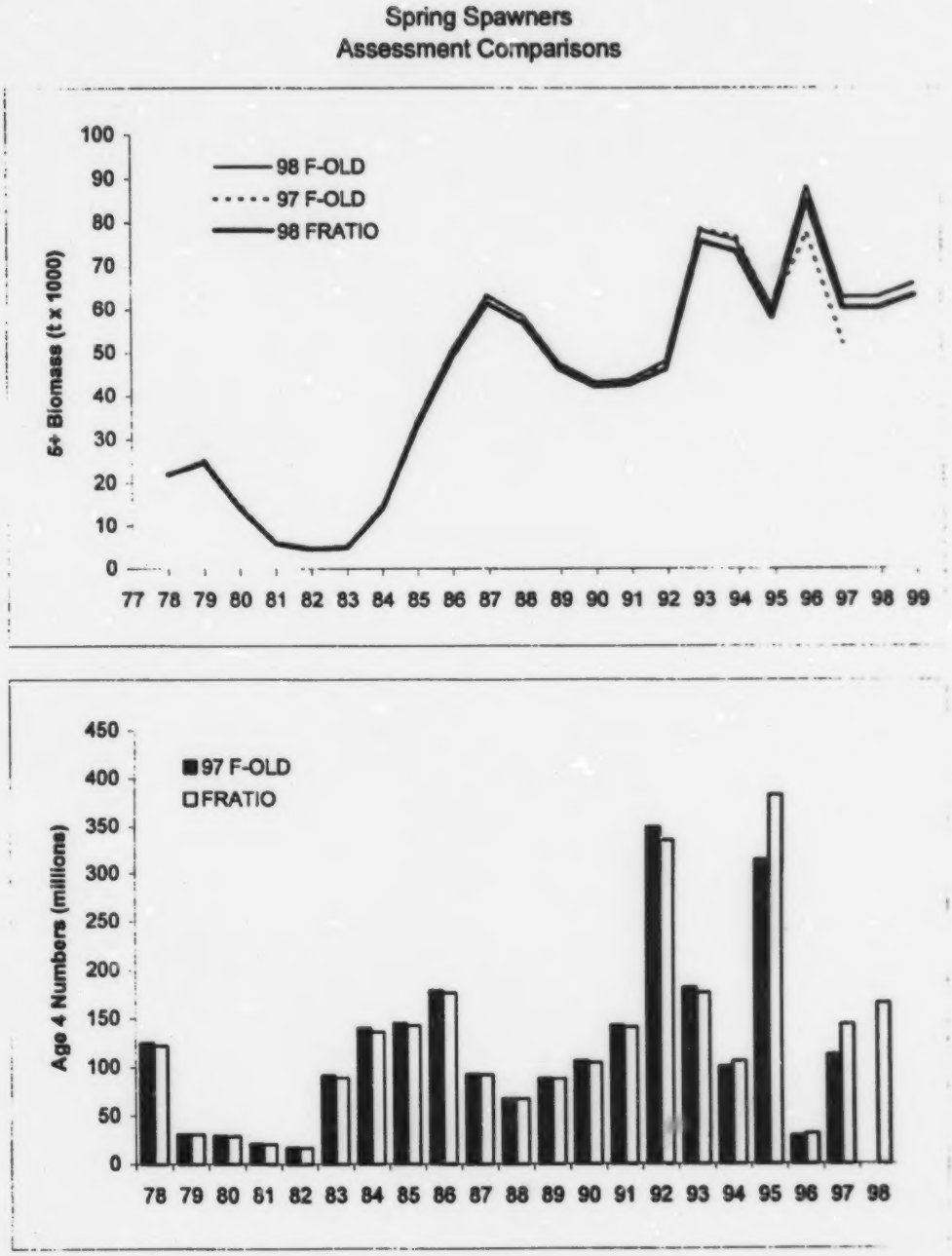


Fig. 35. Comparison of spring spawner population estimates in assessment of 1997 fishery (last year's assessment) using F-OLD and 1998 assessment (this year) using FRATIO and catch rate as the calibration index.

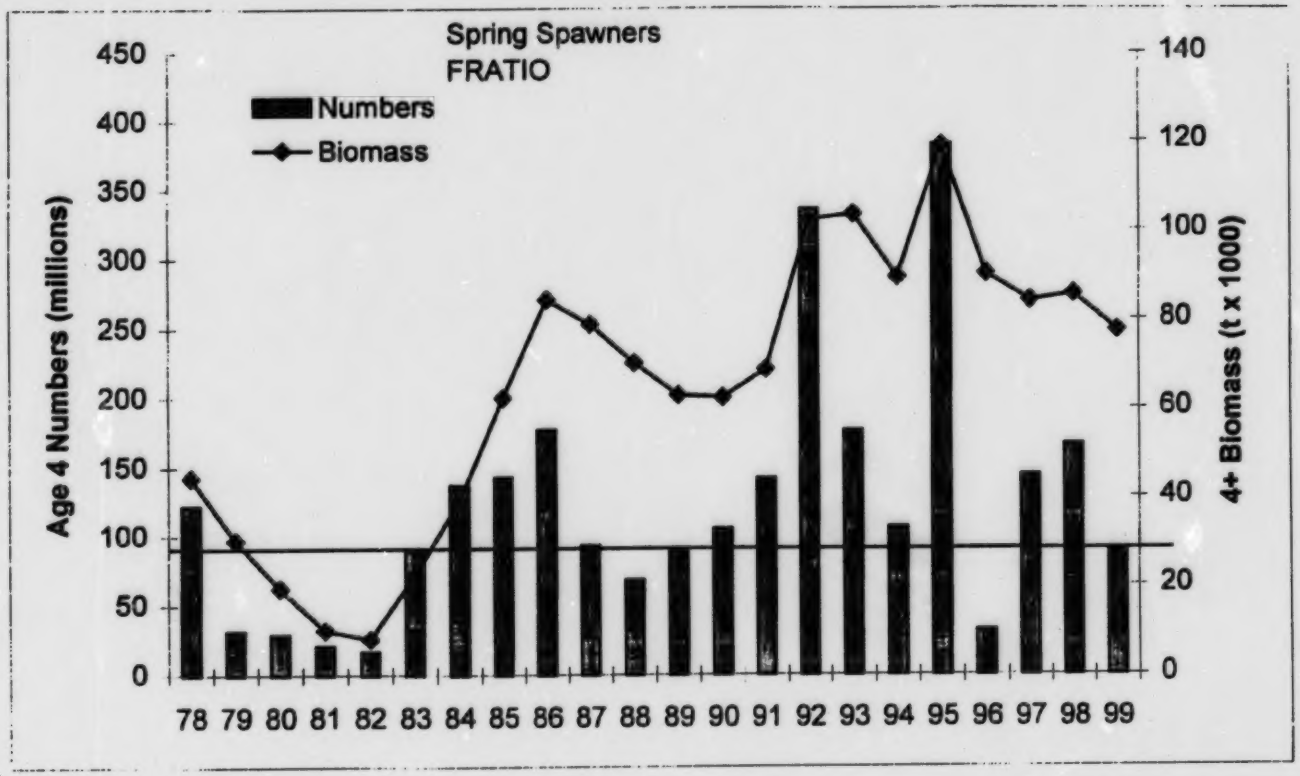


Fig. 36. Recruitment (numbers at age 4), age 4+ biomass, and average recruitment (horizontal line) for spring spawners estimated by ADAPT-VPA FRATIO model.

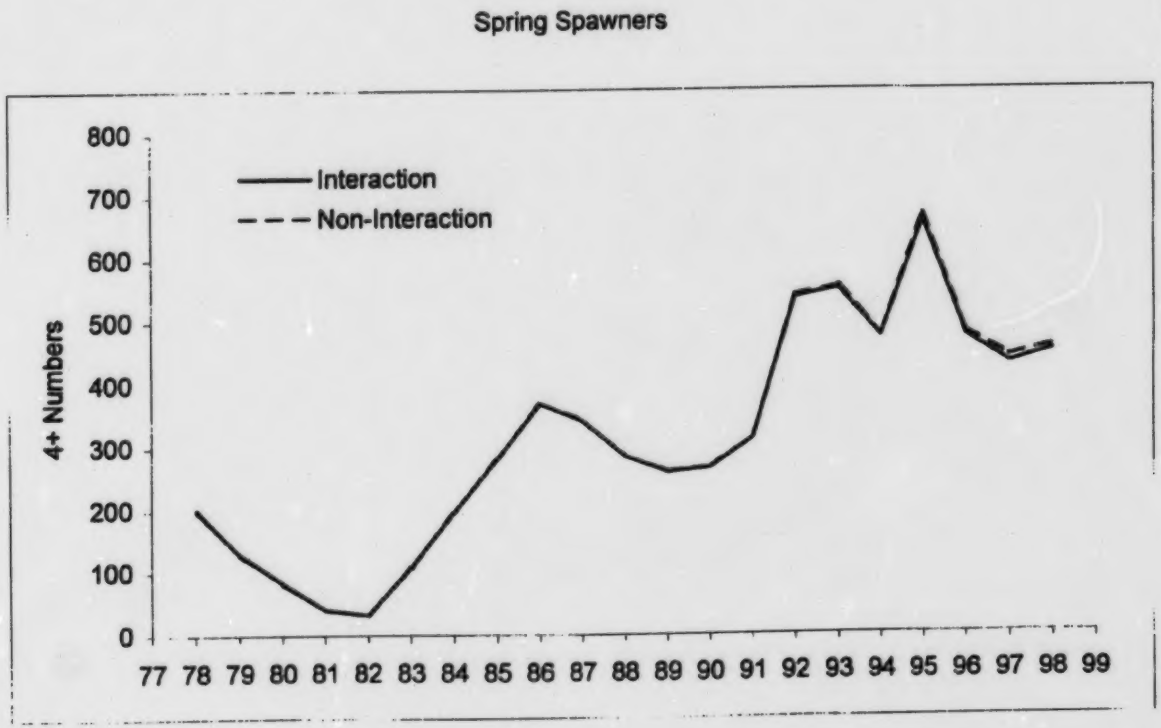


Fig. 37. Comparison of 4+ numbers estimated for spring spawners using catch rates estimated by interaction and non-interaction model to calibrate ADAPT-VPA FRATIO model.

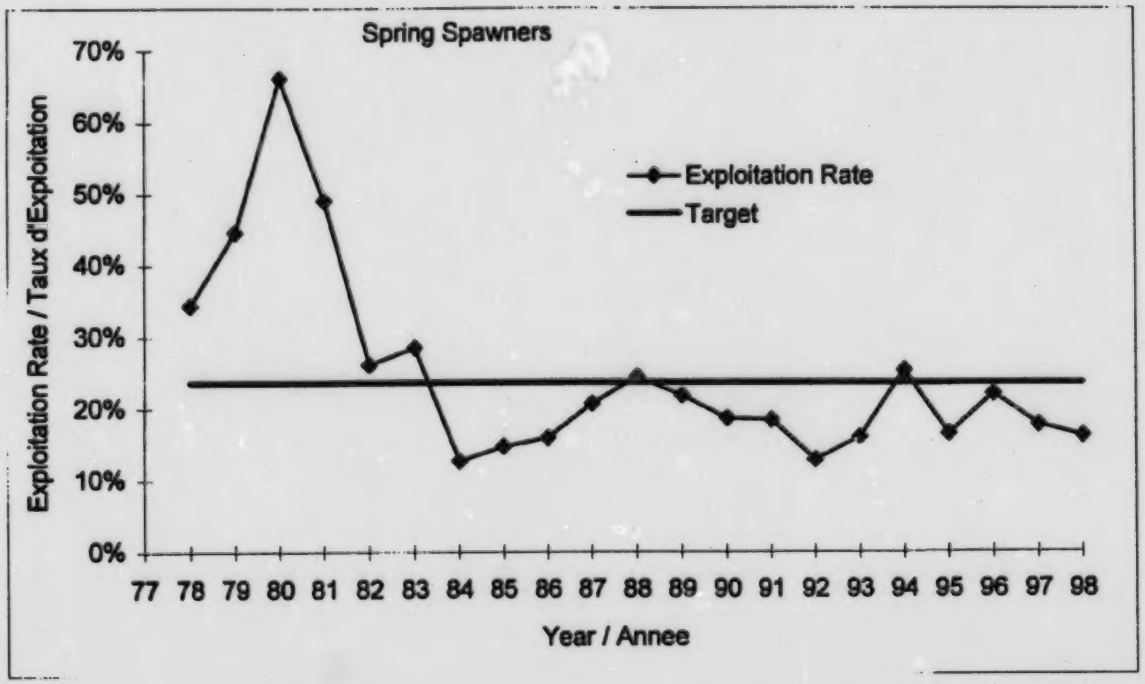


Fig. 38. Estimated fishing mortalities for 4+ spring spawners from ADAPT-VPA FRATIO model

Fig. 38. Estimated fishing mortalities for 4+ spring spawners from ADAPT-VPA FRATIO model using catch rates for calibration compared to target exploitation rate of 24%.

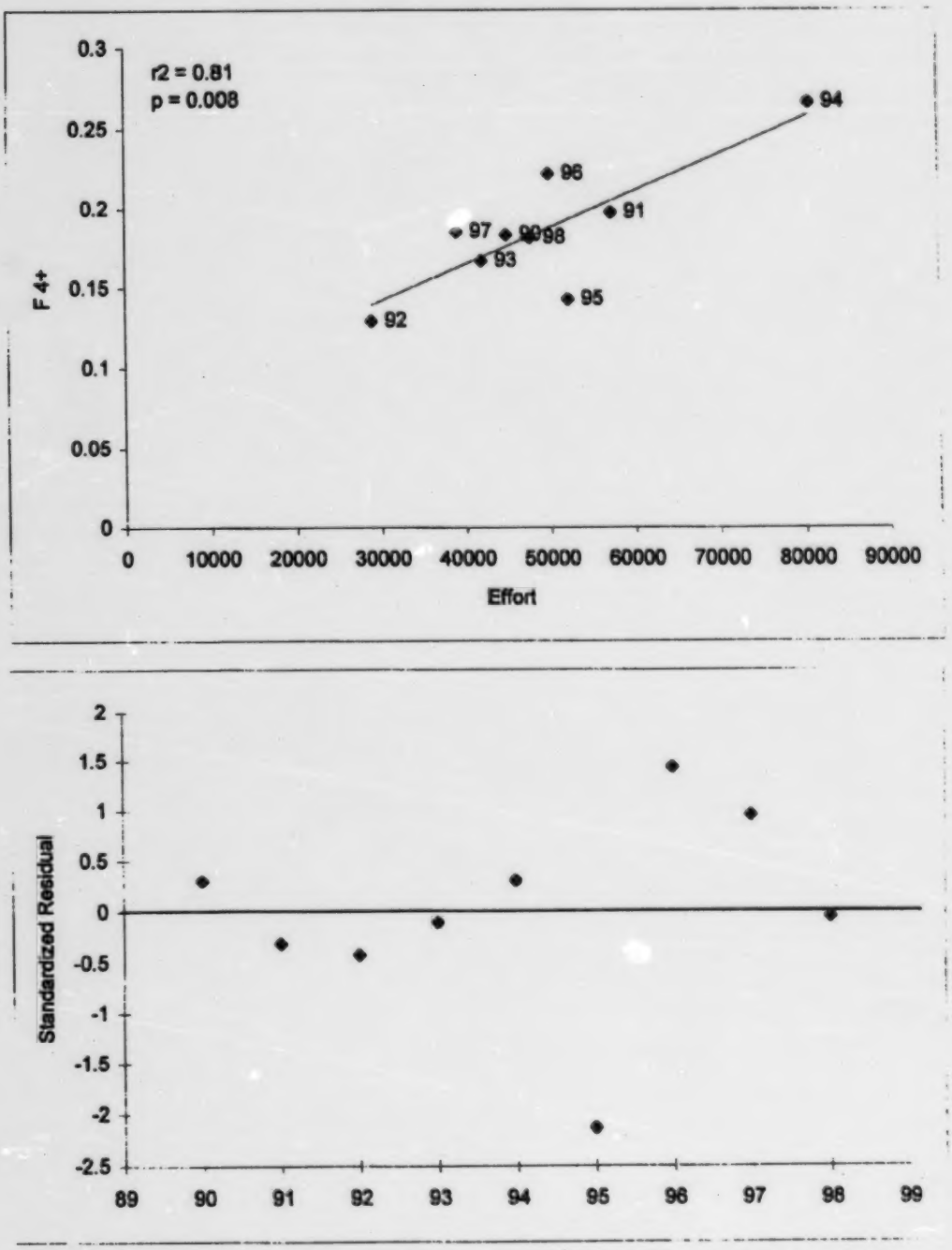


Fig. 39. Relationship between fishing mortality and effort for spring spawners from ADAPT-VPA FRATIO model using catch rates for calibration.

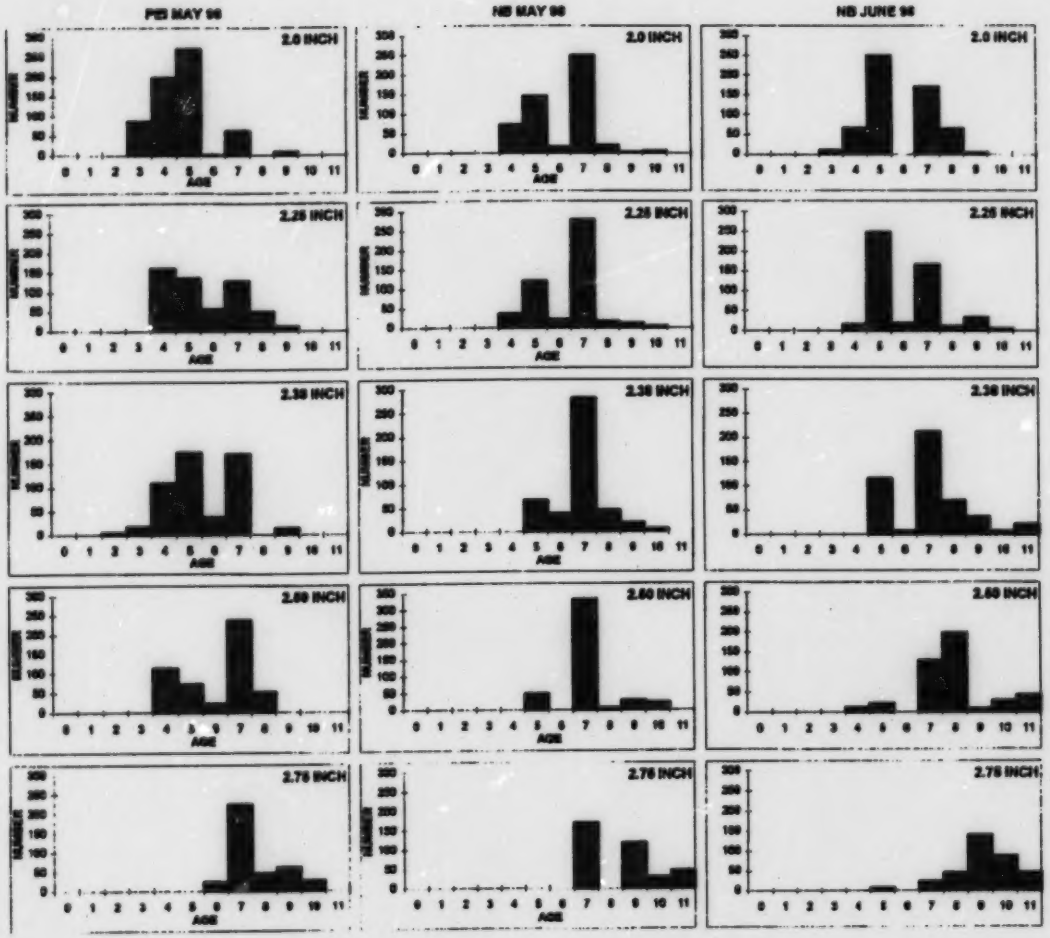


Fig. 40. Comparison of age structure in experimental nets for indicated mesh size fished in southeast N. B. and west P.E.I. in spring of 1998. Landings used = 100t

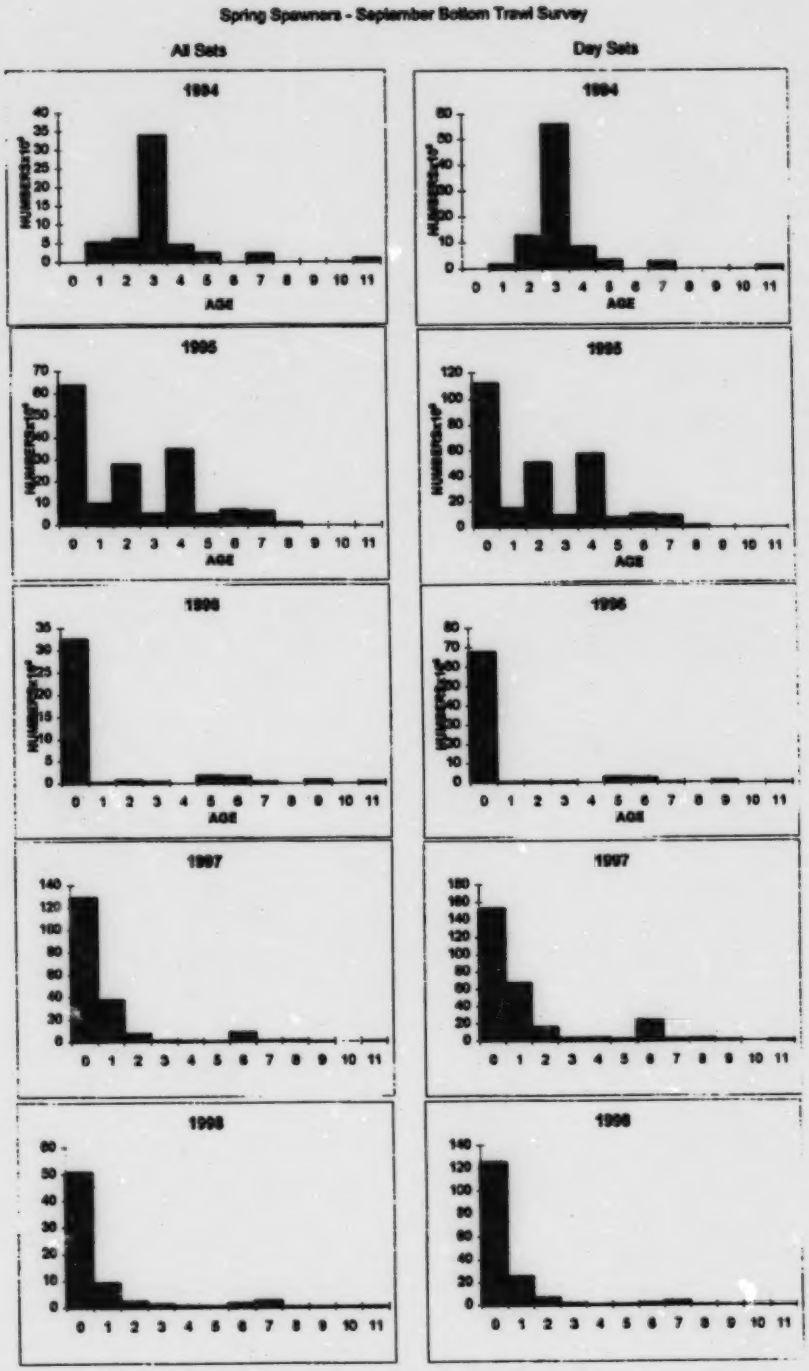


Fig. 41. Spring spawner numbers-at-age from September bottom trawl survey.

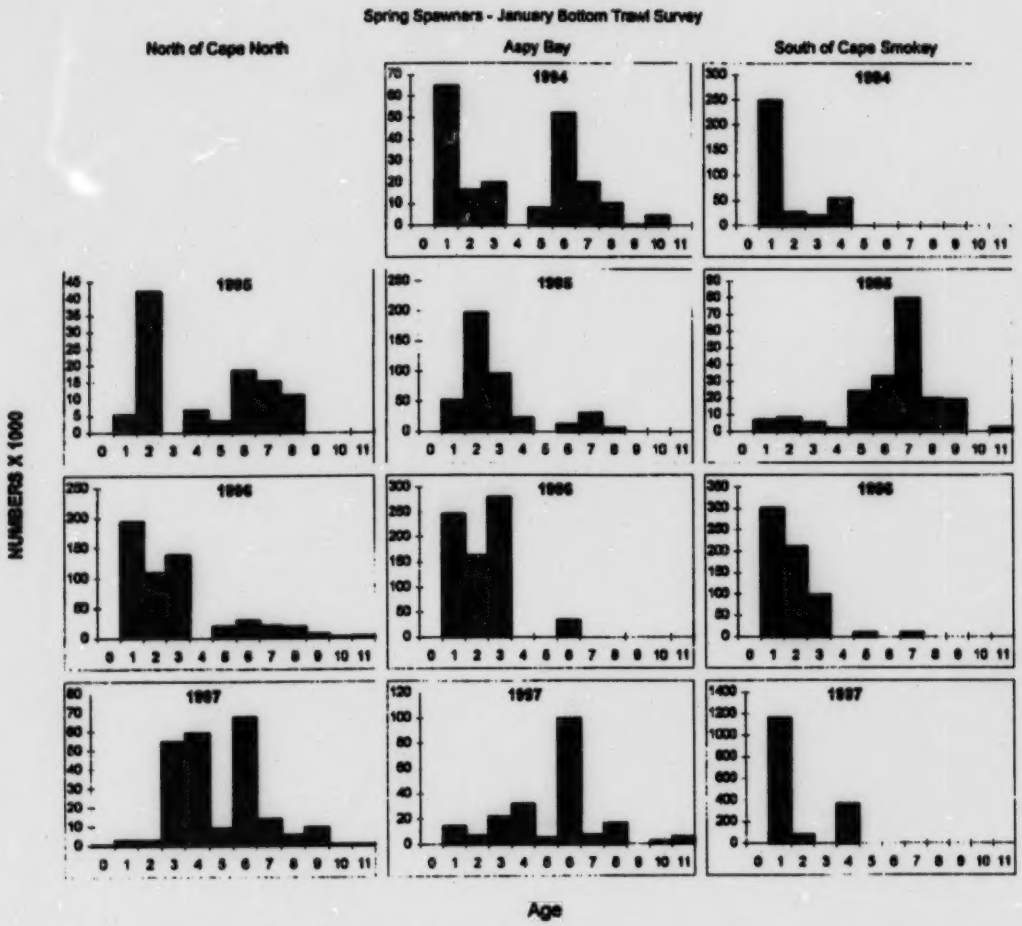


Fig. 42. Numbers-at-age from January bottom trawl survey for spring spawners.

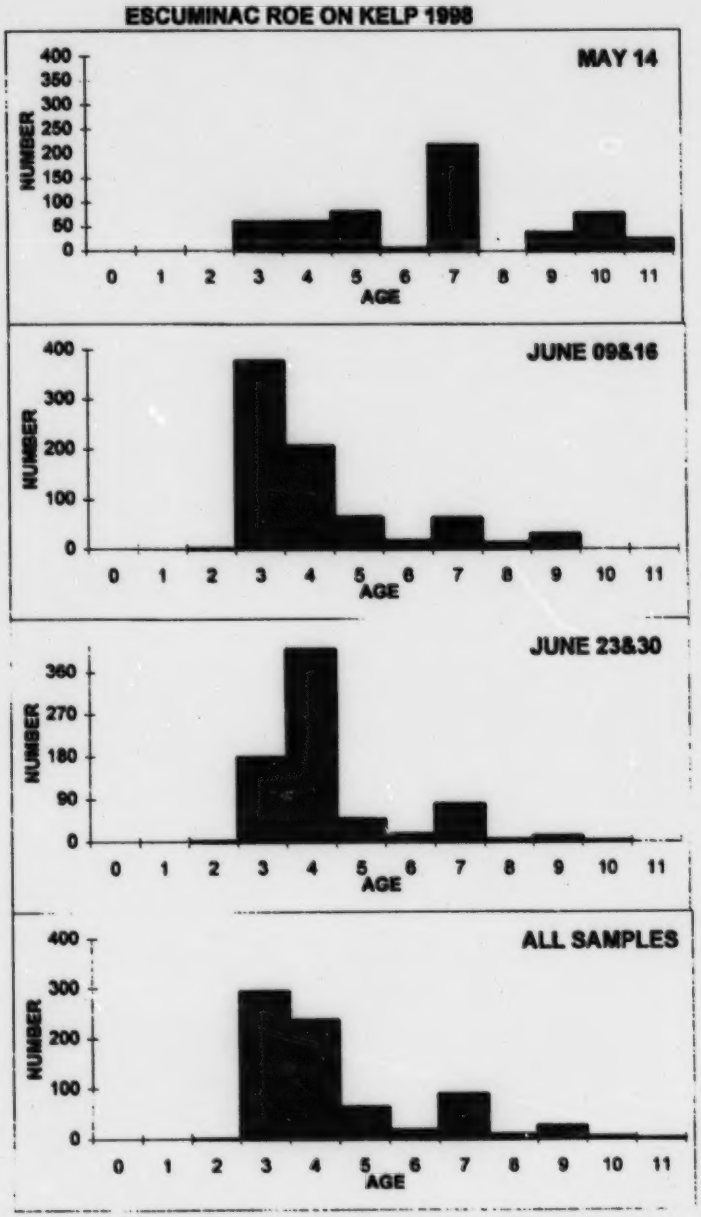


Fig. 43. Comparison of age structure in spring 1998 Escumunac roe on kelp trap nets. Landings used = 100t

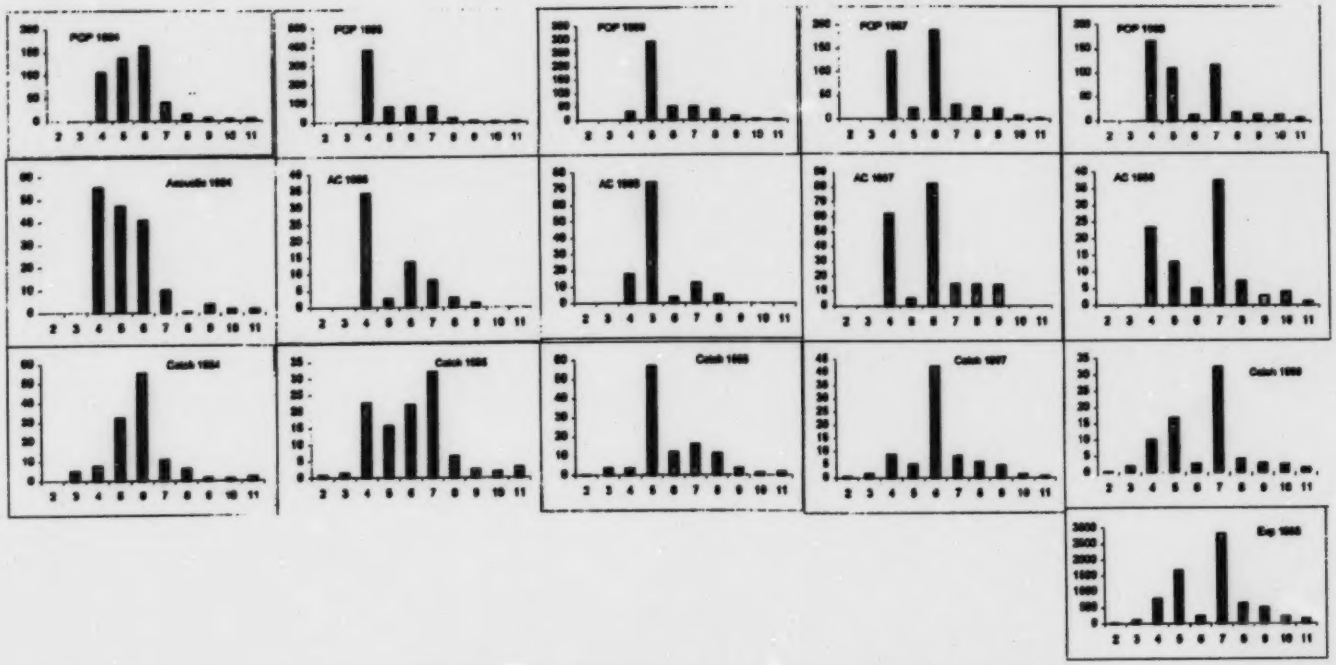


Fig. 44. Spring spawner numbers-at-age from ADAPT-VPA FRATIO CUE compared to numbers in acoustic survey, catch, and experimental nets.

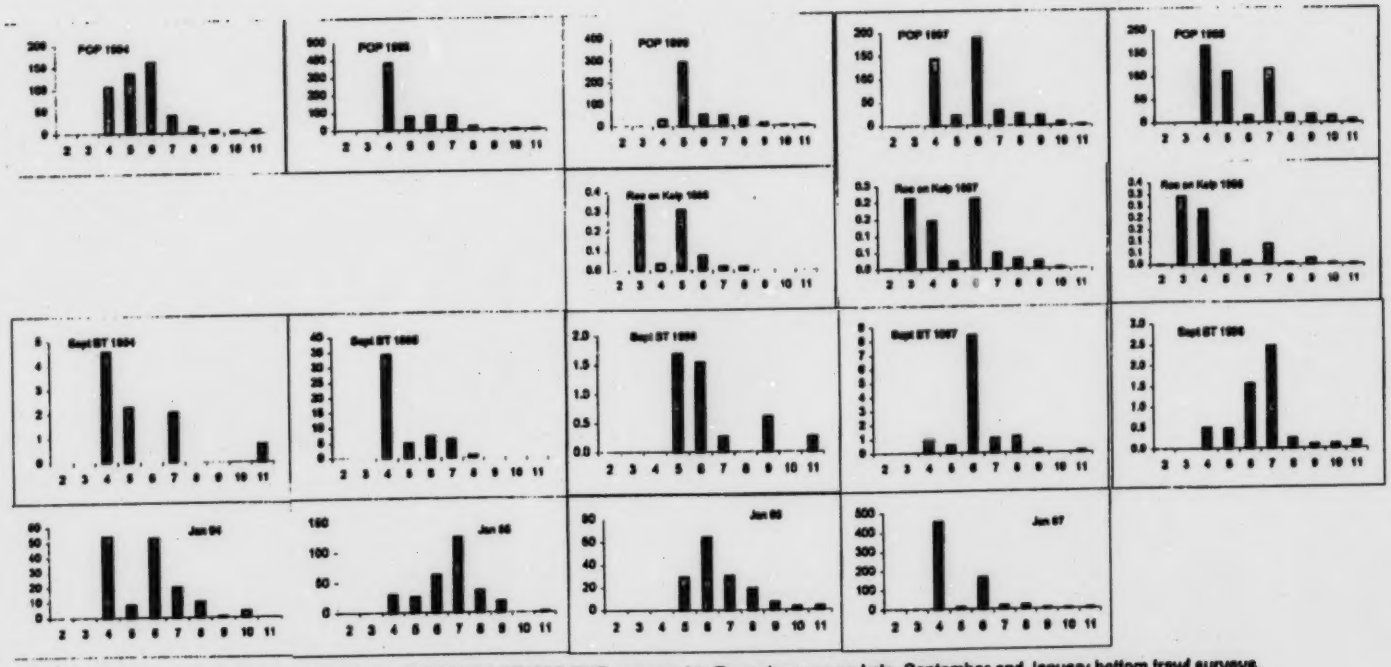


Fig. 45. Spring spawner numbers-at-age from ADAPT-VPA FRATIO CUE compared to Escuminac roe-on-kelp, September and January bottom trawl surveys.

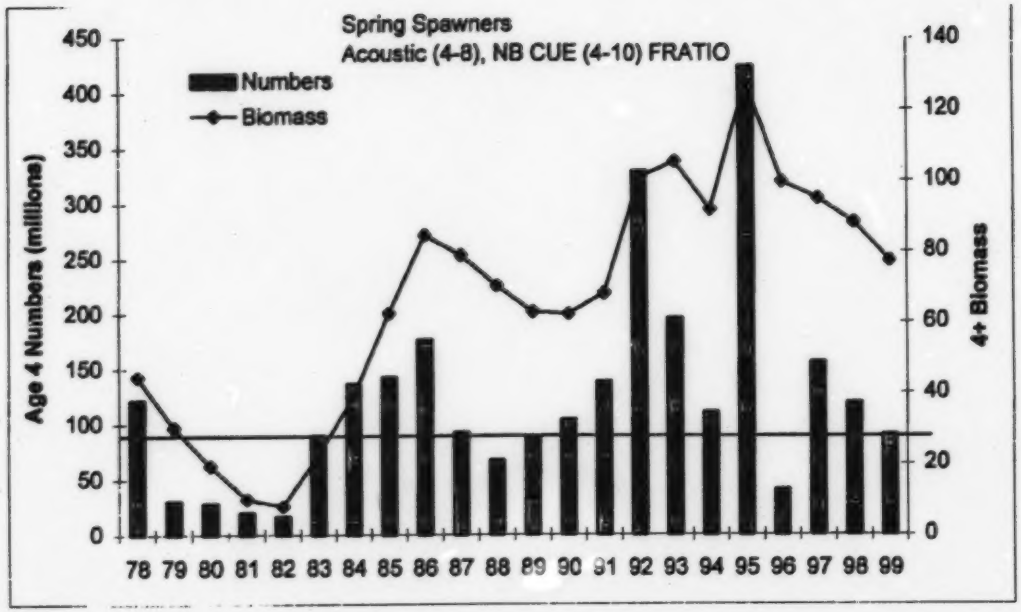


Fig. 46. Age 4 numbers, 4+ biomass, and average recruitment (horizontal line) as estimated by ADAPT-VPA using acoustic and catch rate indices for calibration.

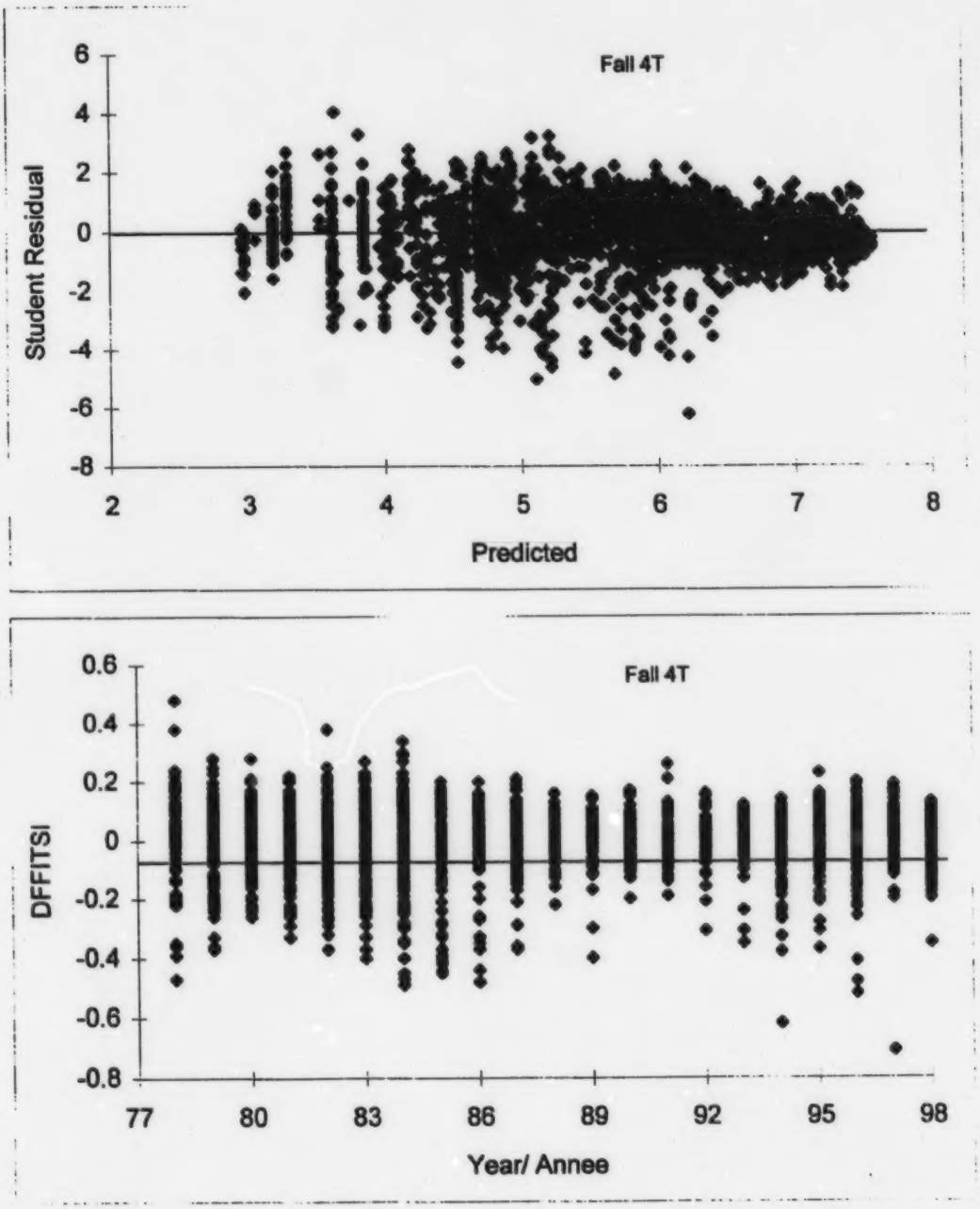


Fig. 47. Diagnostics for 4T fall spawners from multiplicative catch rate analysis.

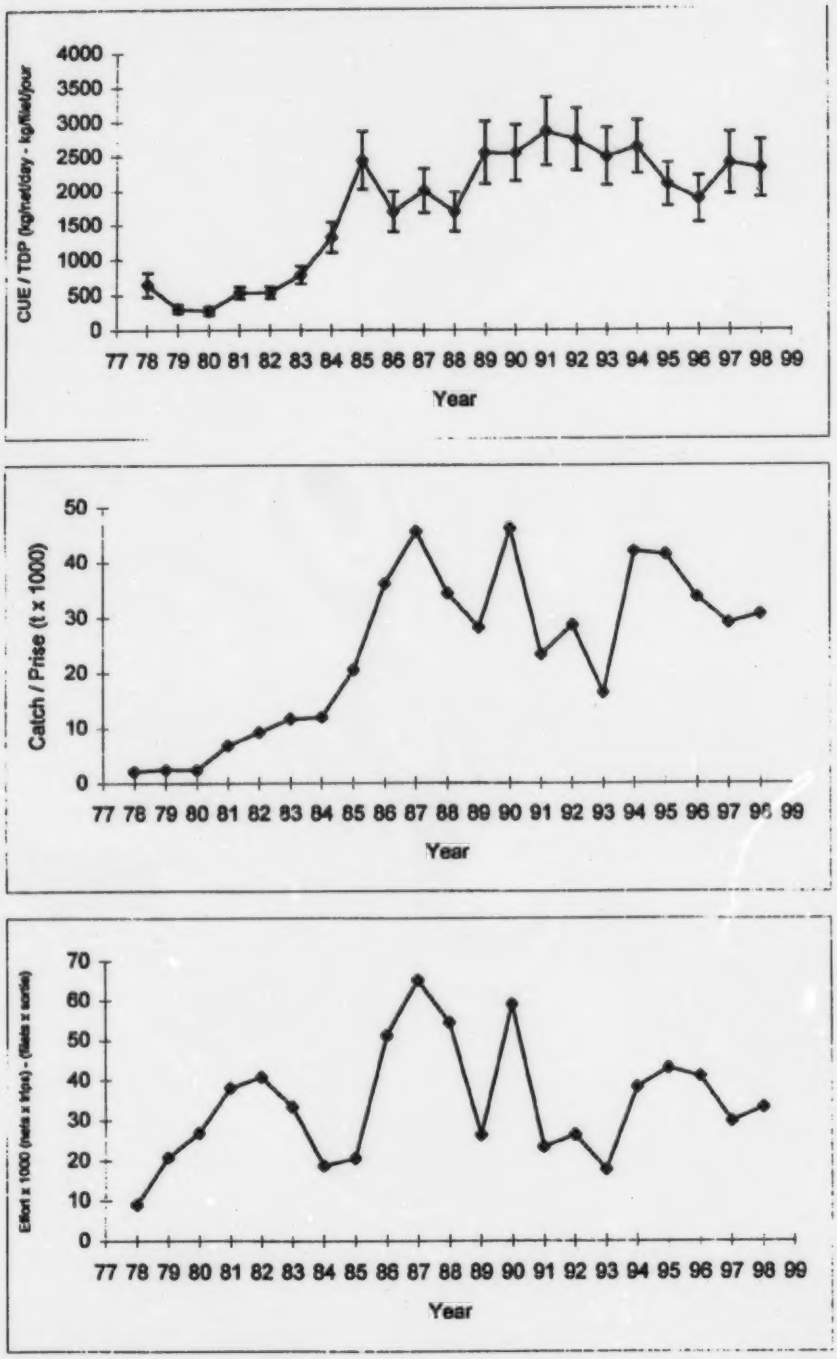


Fig. 48. Fall spawner catch rates (top), catch (middle), and effort (bottom).

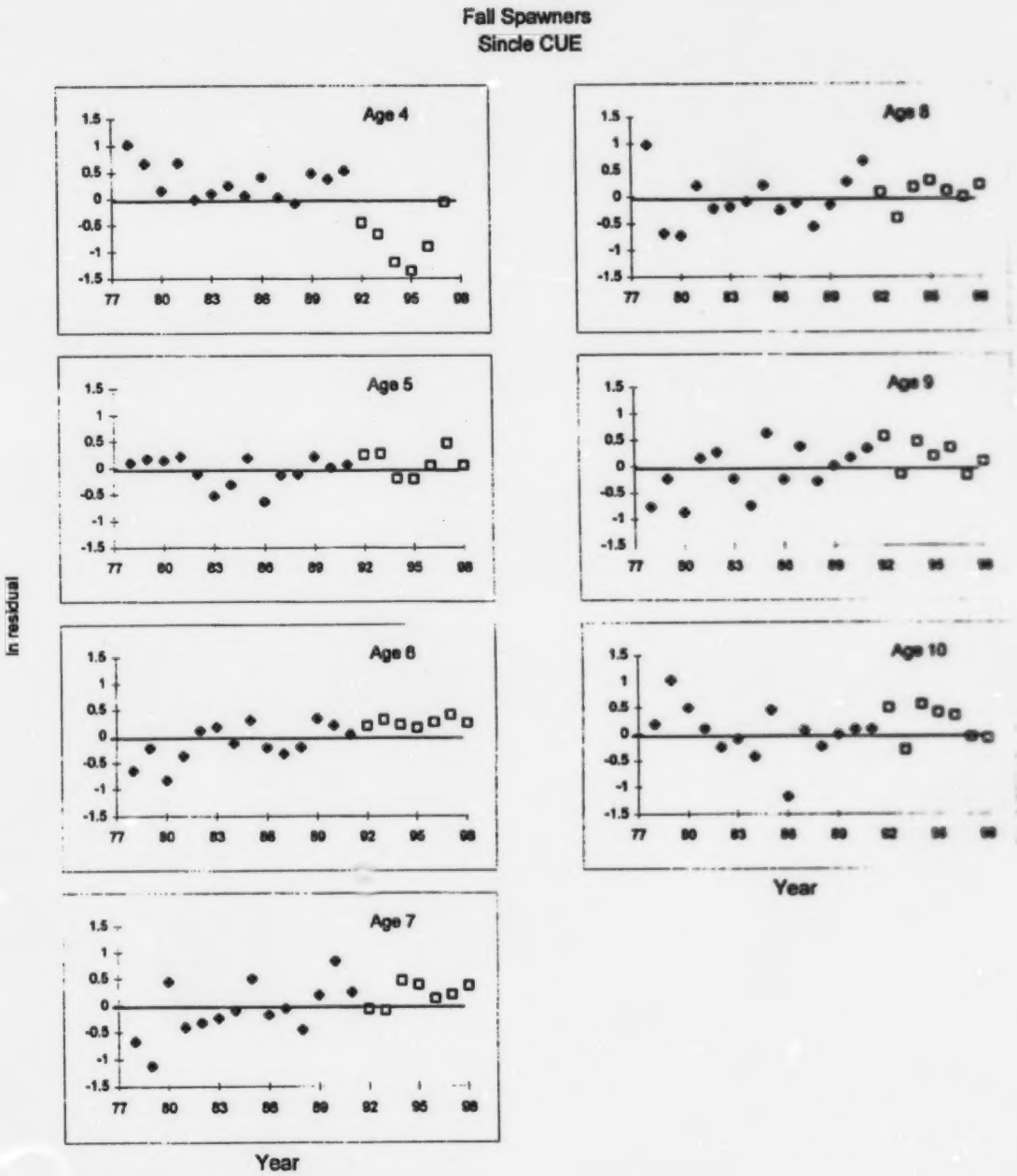


Fig. 49. Fall spawner residuals from ADAPT-VPA using single CUE to calibrate model. Open squares represent years with larger mesh sizes.

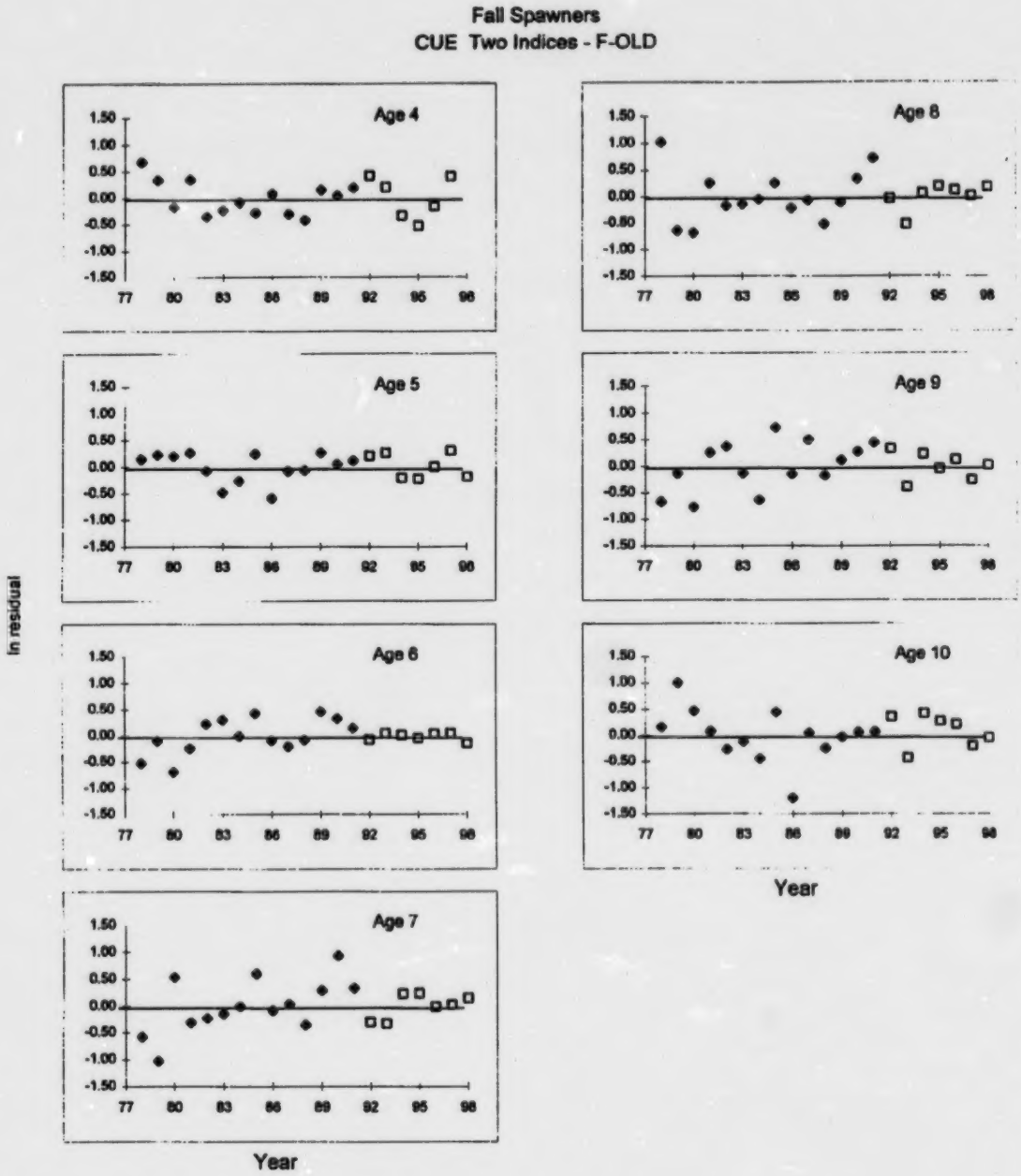


Fig. 50. Residuals from ADAPT-VPA using split CUE and F-OLD for fall spawners. Open squares represent years with larger mesh sizes.

Fall Spawner
Select CUE FRATIO

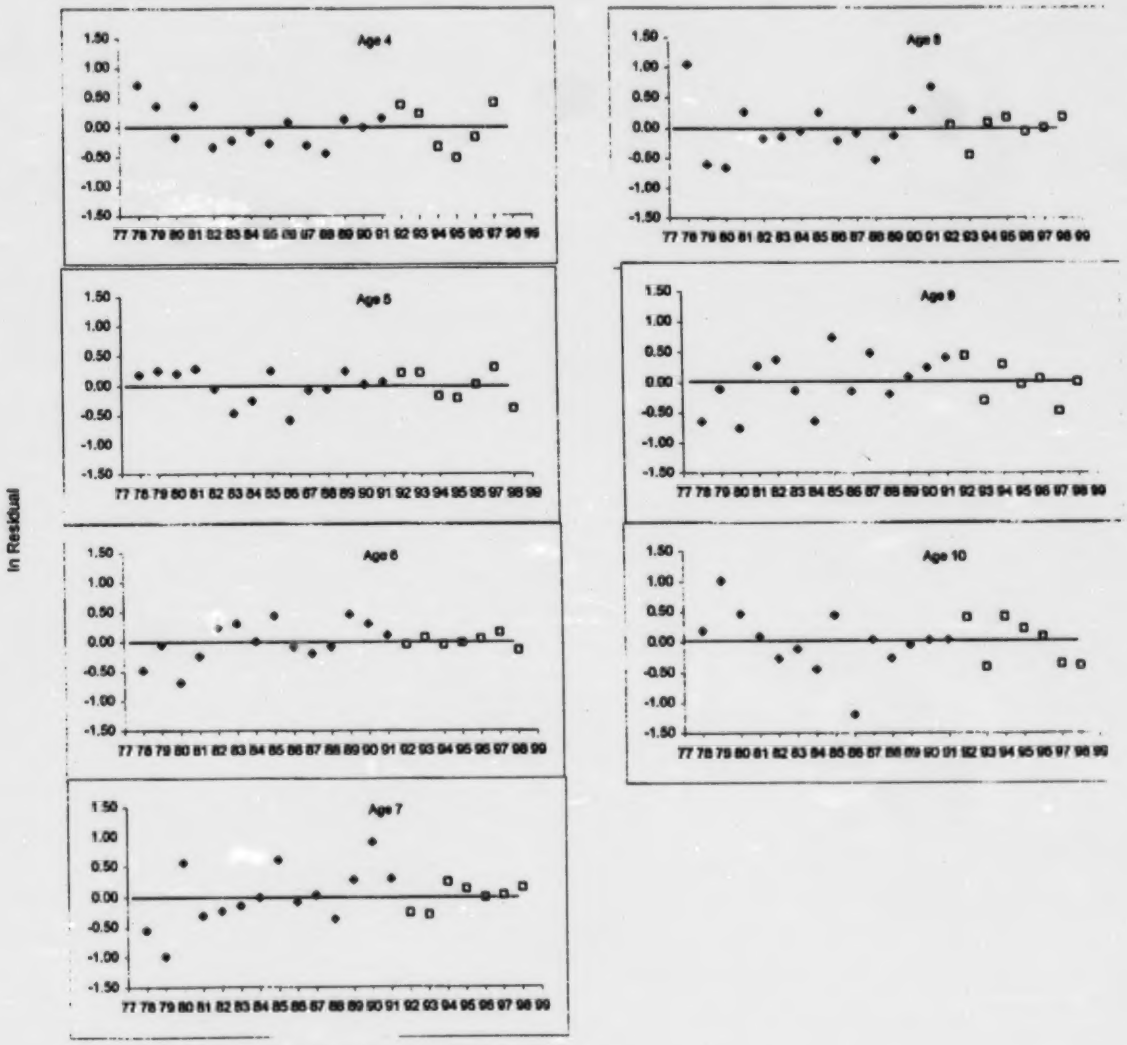


Fig. 51. Residuals from fall spawner ADAPT-VPA using split CUE and FRATIO.

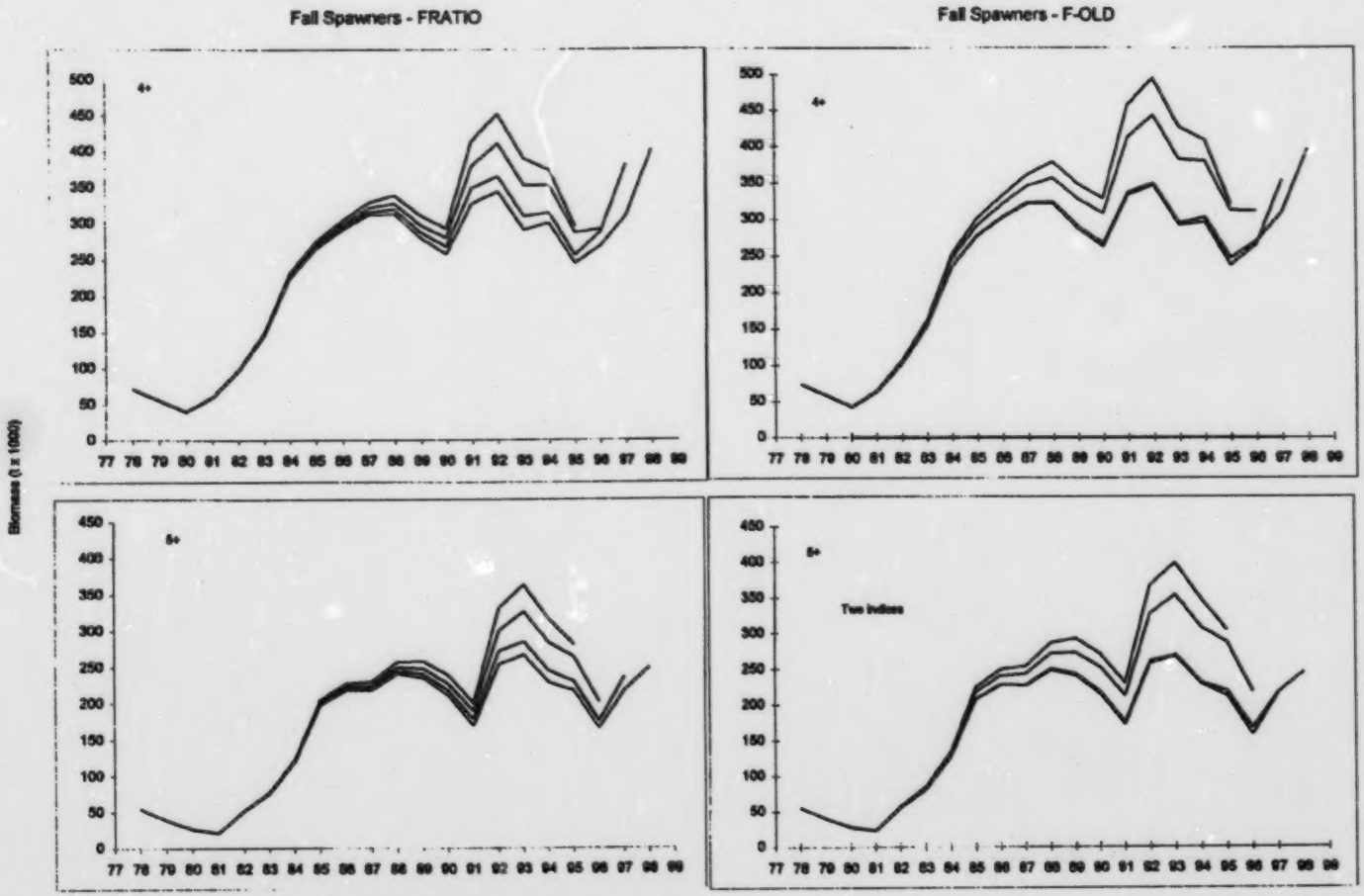


Fig. 62. Fall spawner retrospective analysis of ADAPT-VPA split CUE F-OLD and FRATIO models.

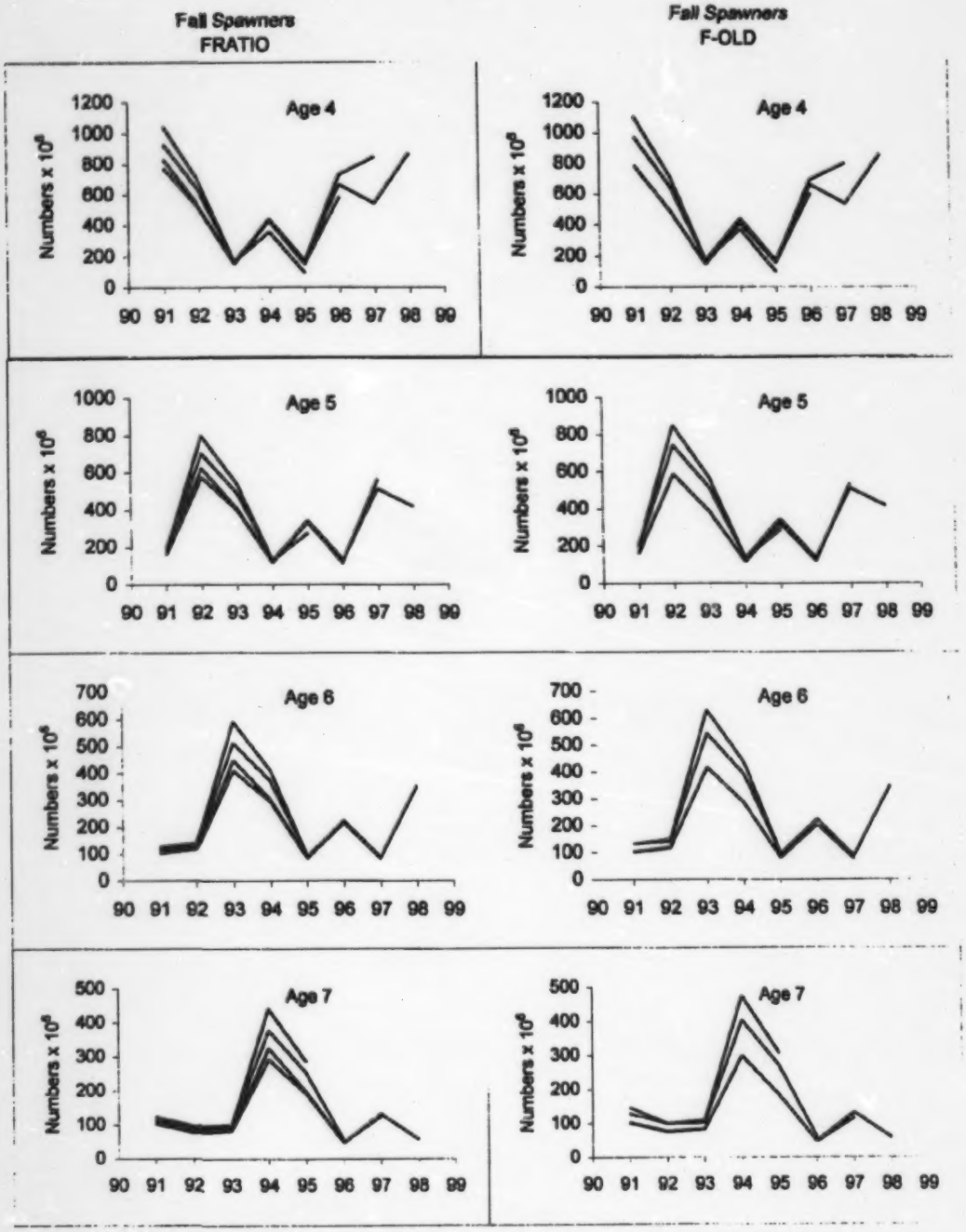


Fig. 53. Retrospective analysis by age for fall spawner ADAPT-VPA F-OLD and FRATIO models using split CUE indices.

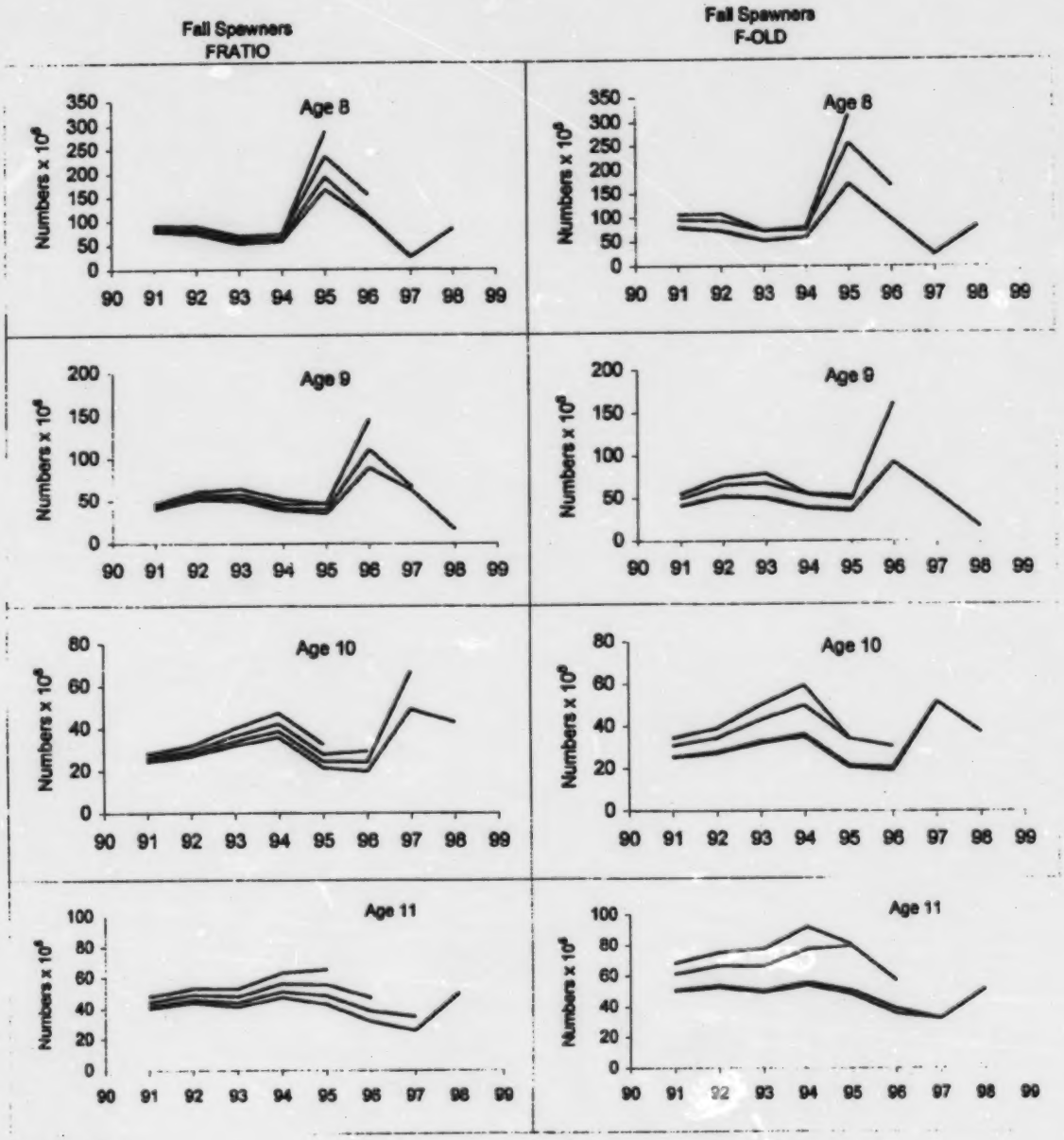

Fall Spawners
FRATIO
Fall Spawners
F-OLD
Age 8
Age 9
Age 10
Age 11
Numbers x 10^6
90 91 92 93 94 95 96 97 98 99

Fig. 53. Cont.

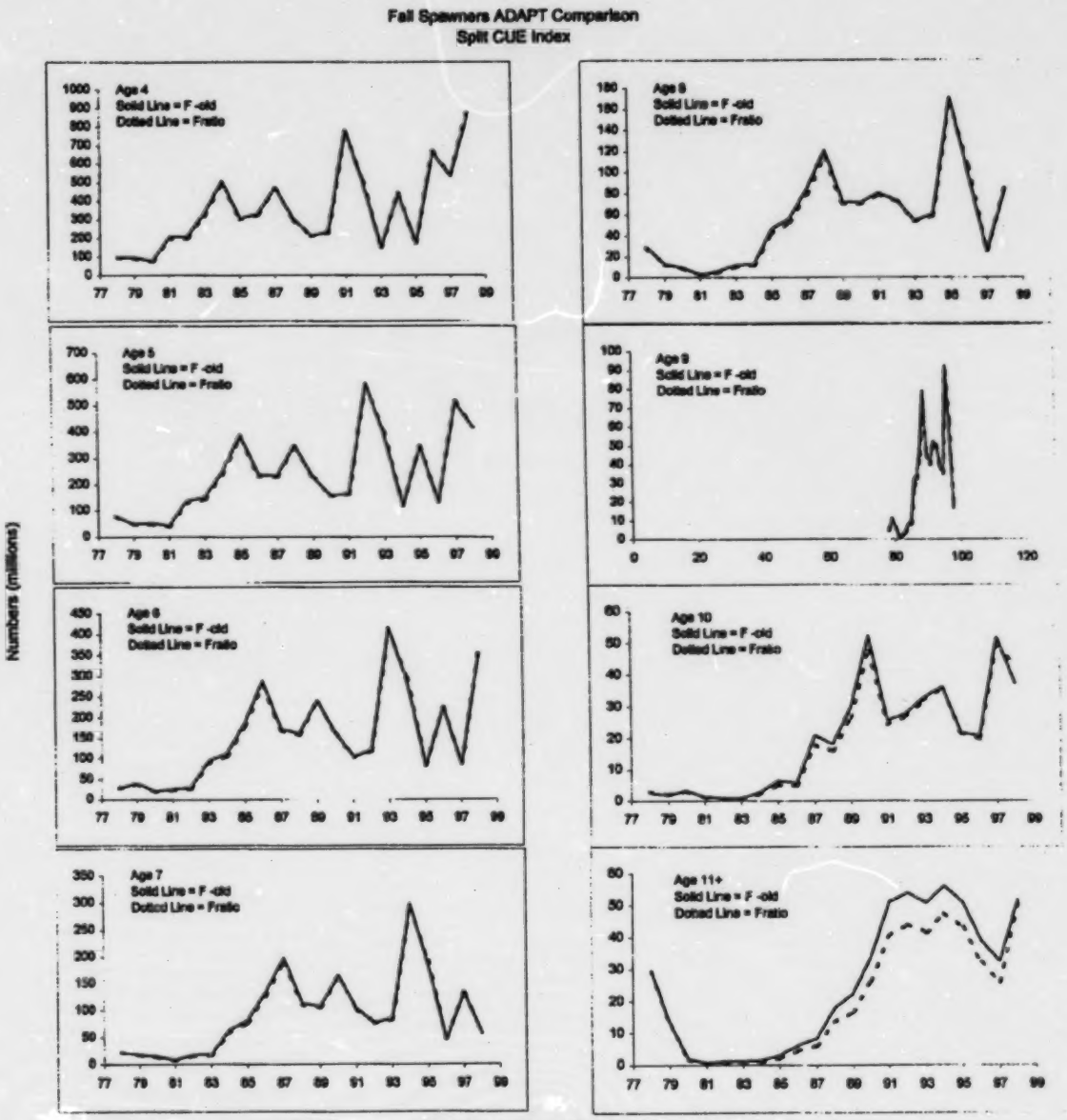


Fig. 54. Numbers-at-age estimates for fall spawners from ADAPT-VPA F-OLD and FRATIO split CUE models.

Fall Spawner
Acoustic-CUE FRATIO

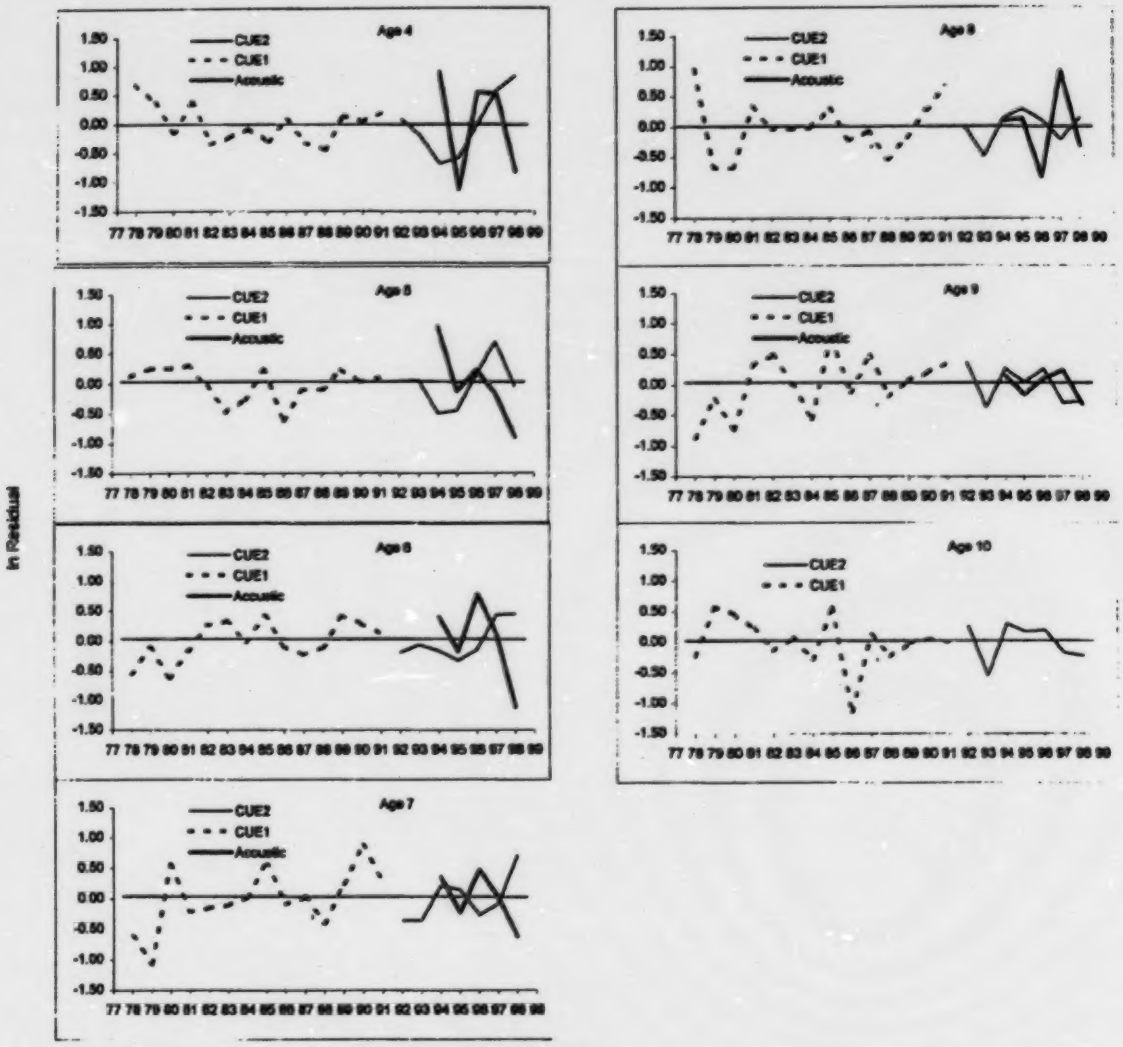


Fig. 55. Fall spawner ADAPT-VPA FRATIO residuals using split CUE and acoustic index.

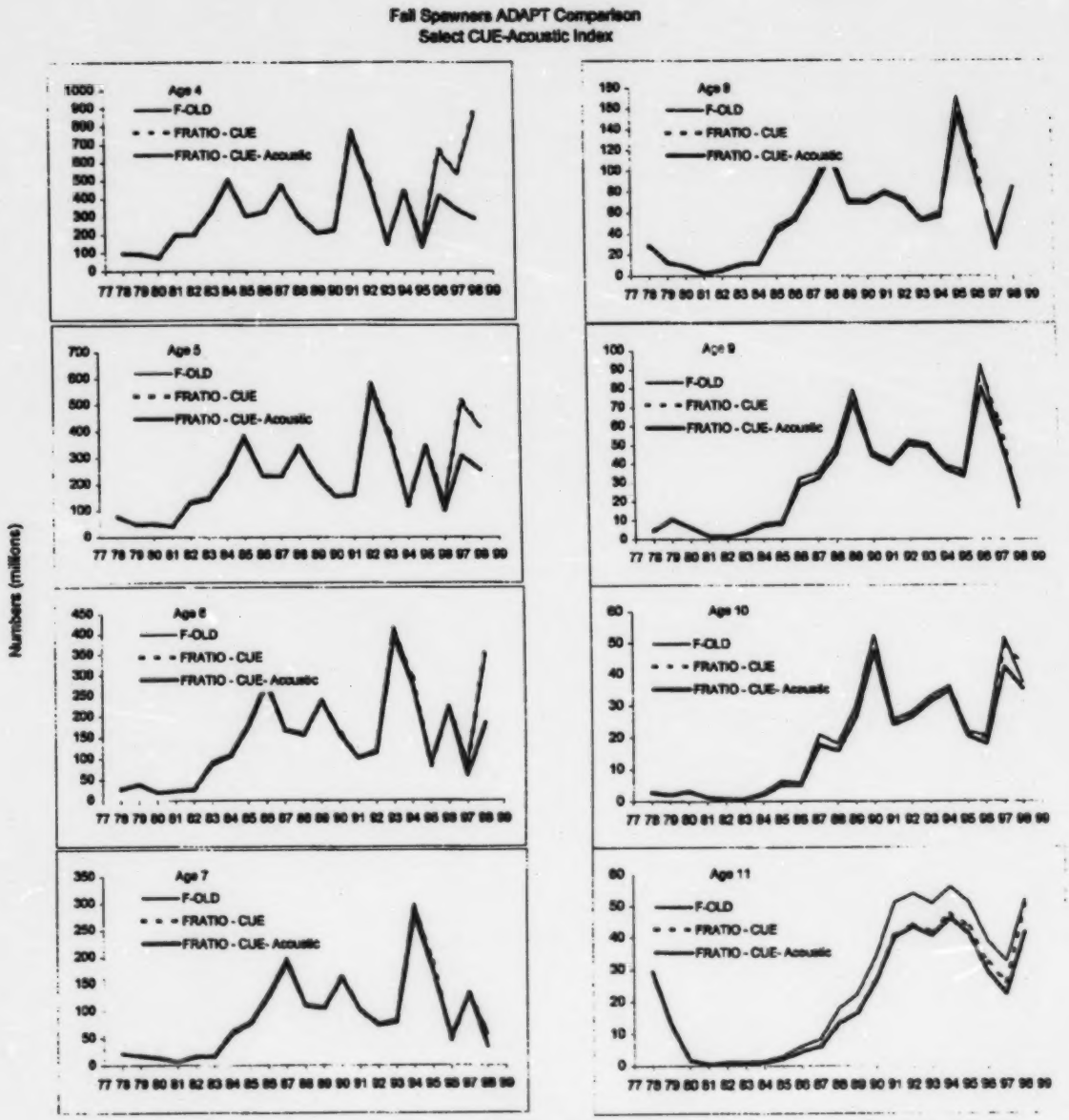


Fig. 56. Fall spawner numbers-at-age from ADAPT-VPA FRATIO using acoustic and split CUE indices, compared to ADAPT-VPA FRATIO and F-OLD split CUE models.

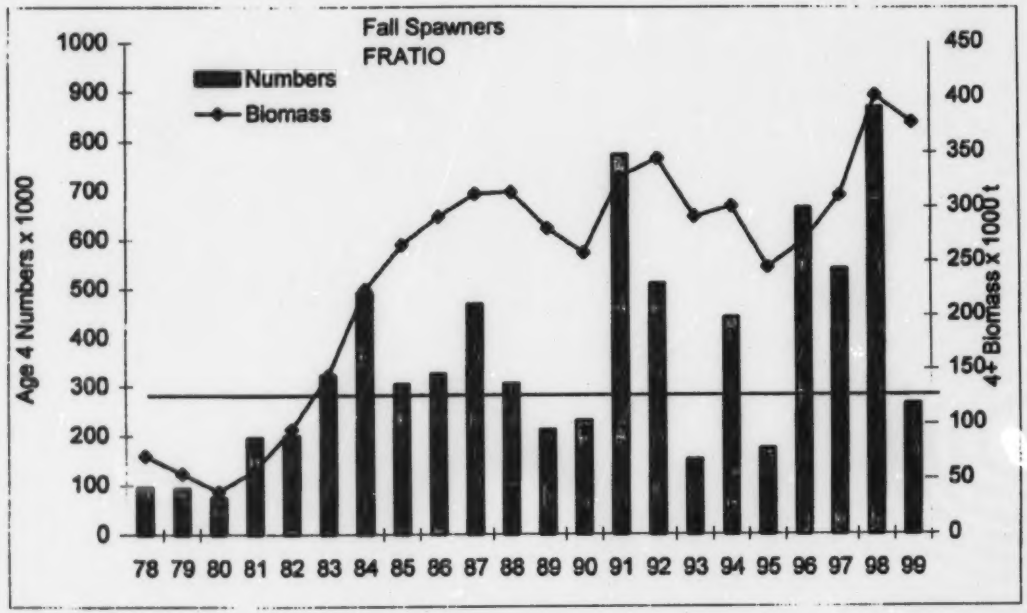


Fig. 57. Age 4 numbers-at-age, 4+ biomass, and average recruitment of age 4 (horizontal line) for fall spawners estimated from ADAPT-VPA FRATIO split CUE model.

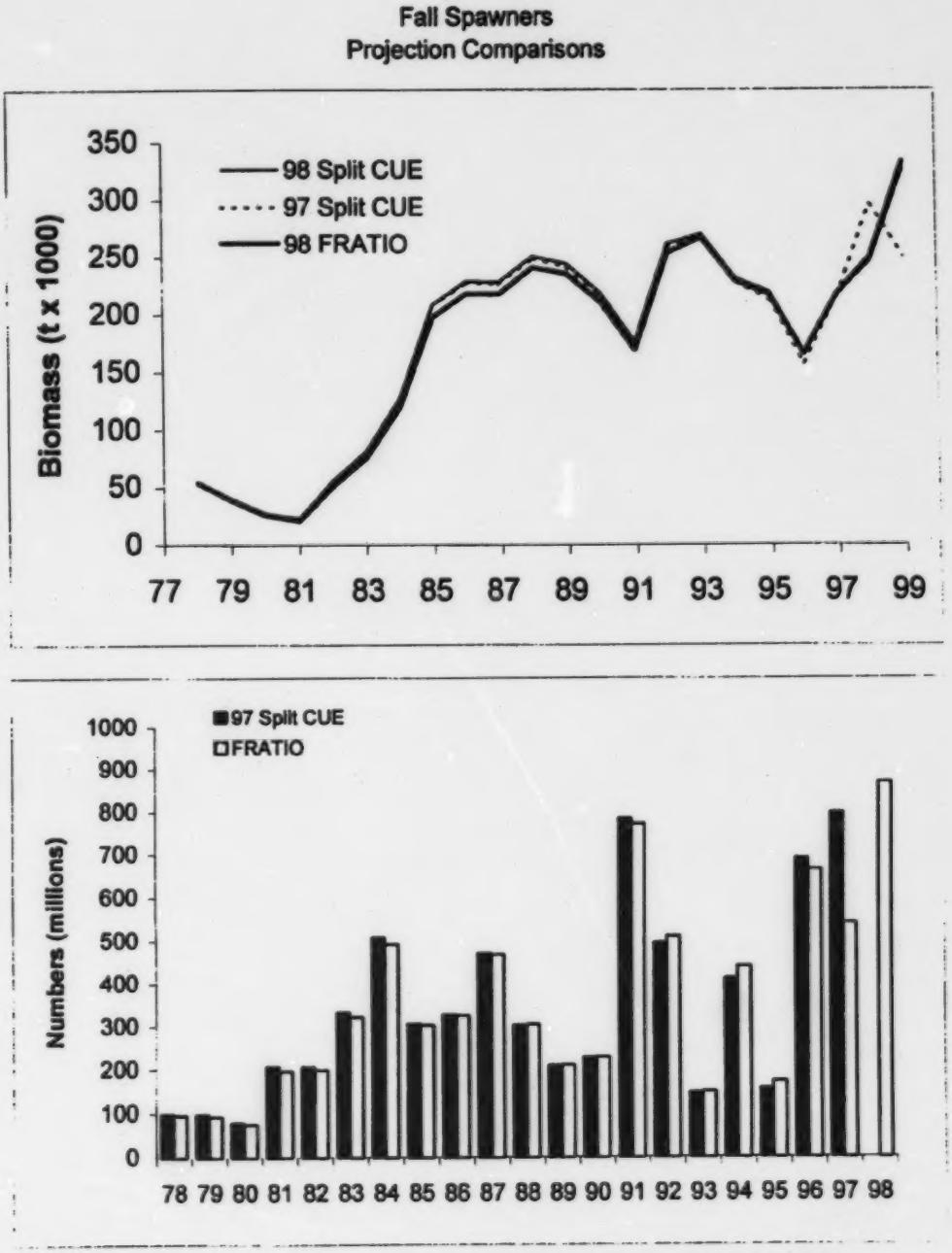


Fig. 58. Fall spawner 5+ biomass and age 4 numbers from ADAPT-VPA FRATIO for 1998 assessment compared to last year's 1997 assessment using F-OLD model.

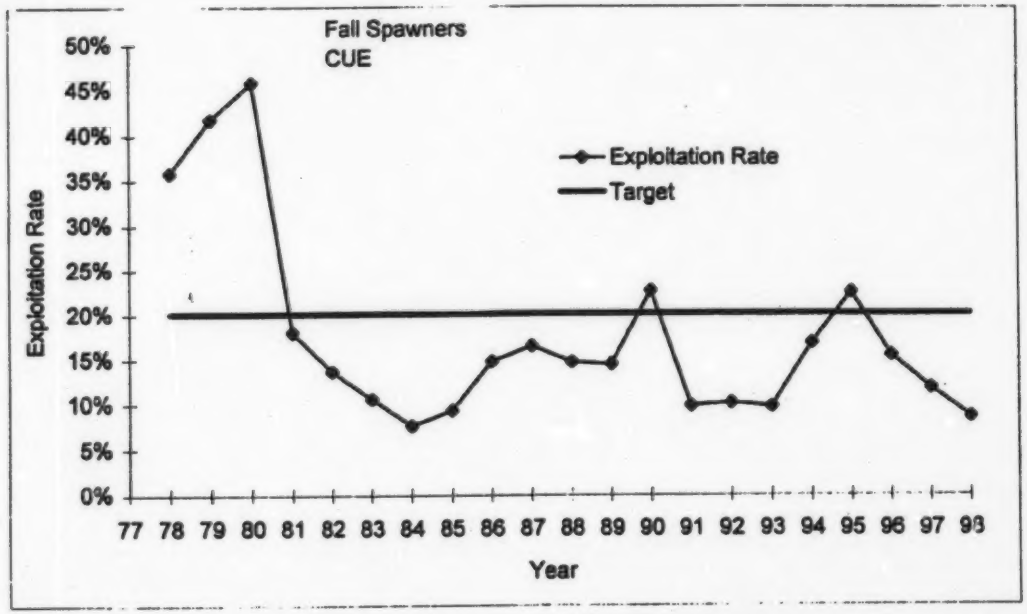


Fig. 59. Estimated fall spawner fishing mortality using ADAPT-VPA FRATIO split CUE compared to 4+ target fishing mortality.

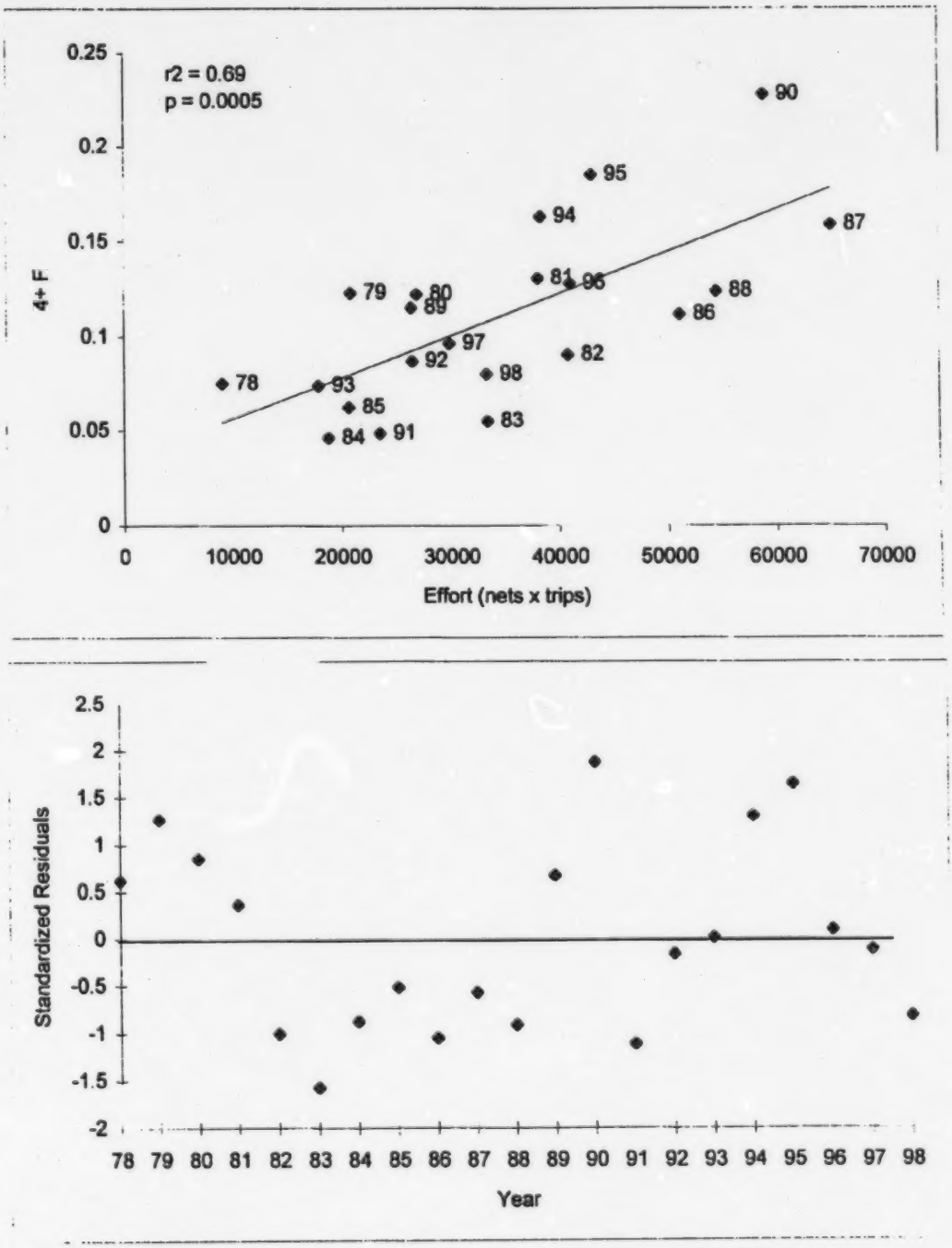


Fig. 60. Relationship between fishing mortality and effort for fall spawners estimated using ADAPT-VPA and split CUE.

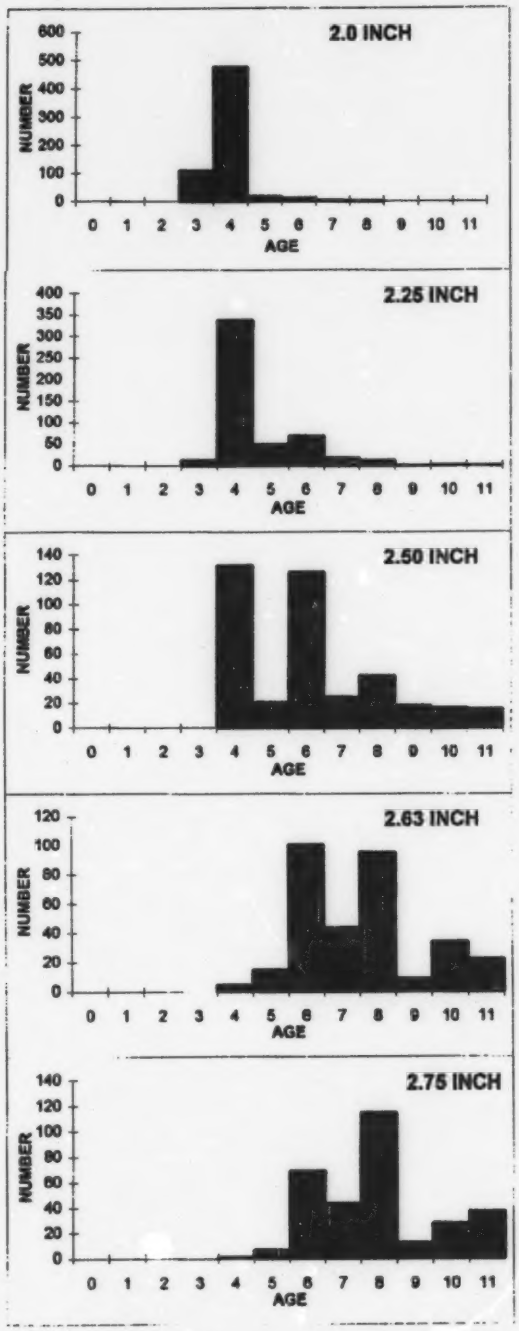


Fig. 61. Comparison of age structure in experimental nets for indicated mesh size fished in Pictou, N.S. in fall of 1998.

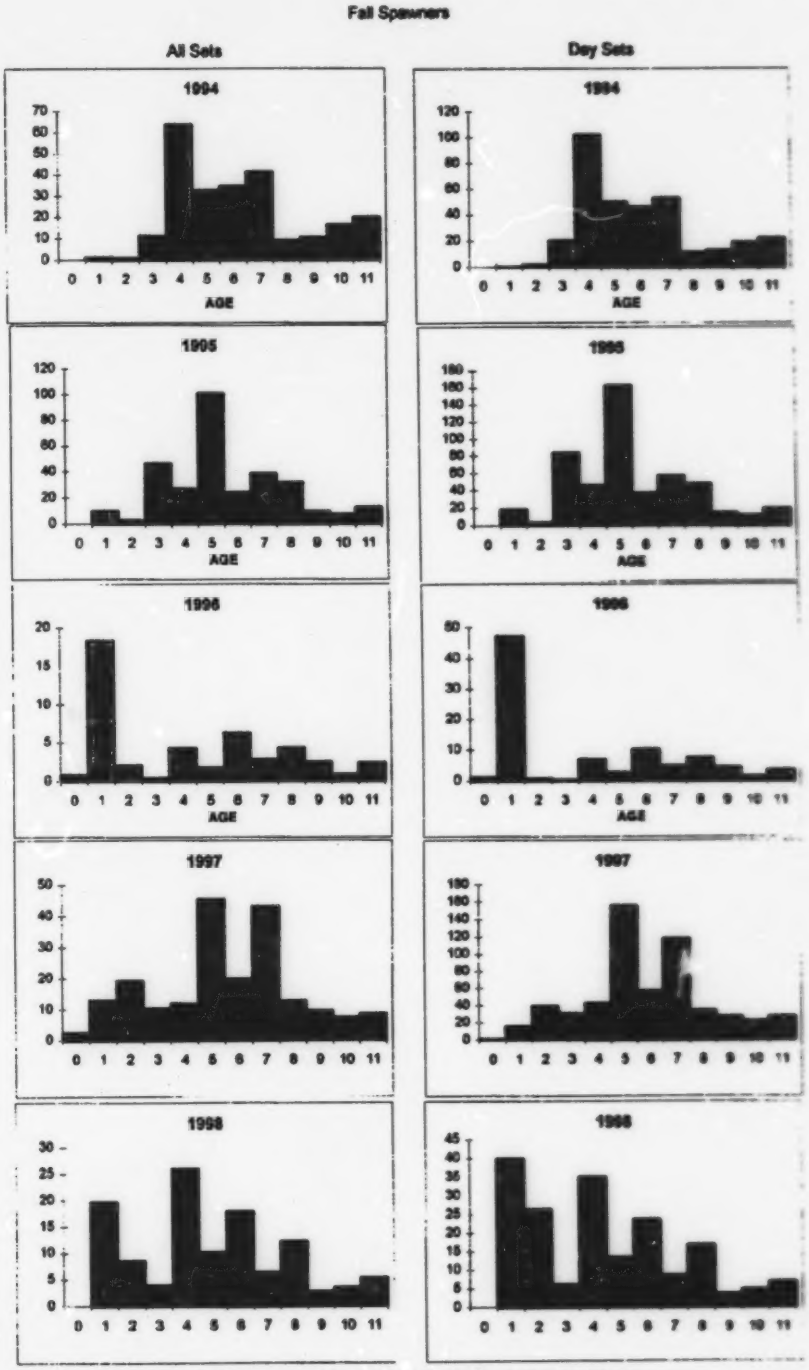


Fig. 62. Fall spawners numbers-at-age estimated from September bottom trawl survey.

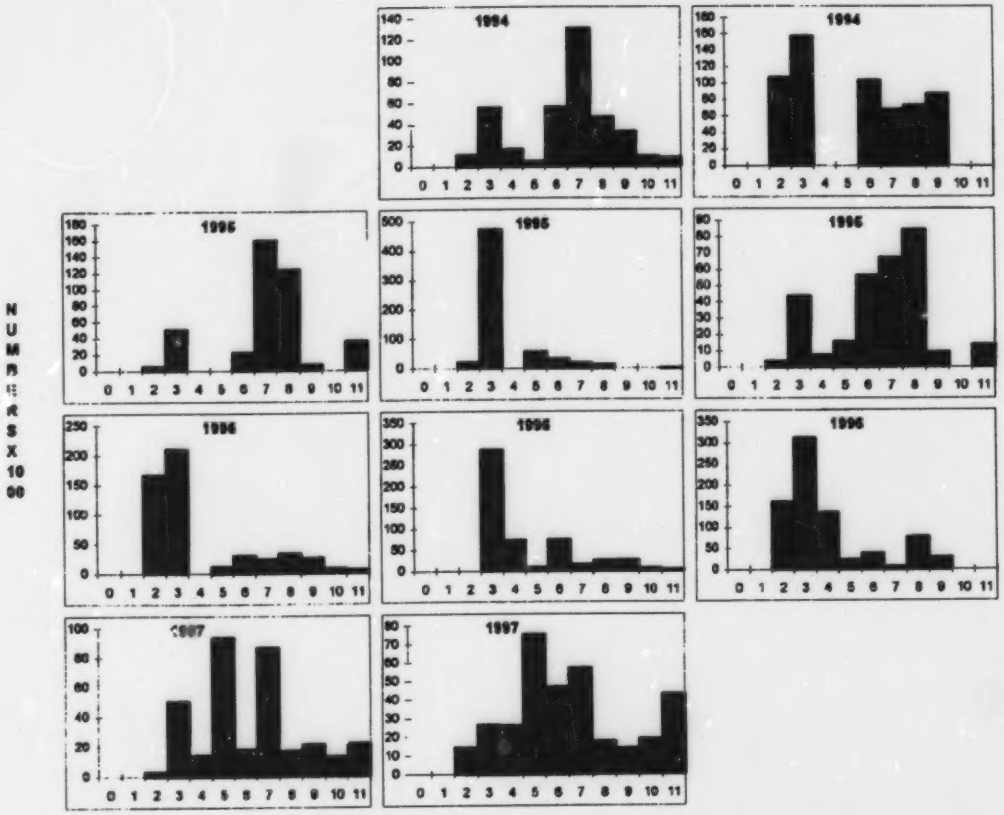


Fig. 63. Fall spawner numbers-at-age from January bottom trawl surveys in 4Vn.

Fall

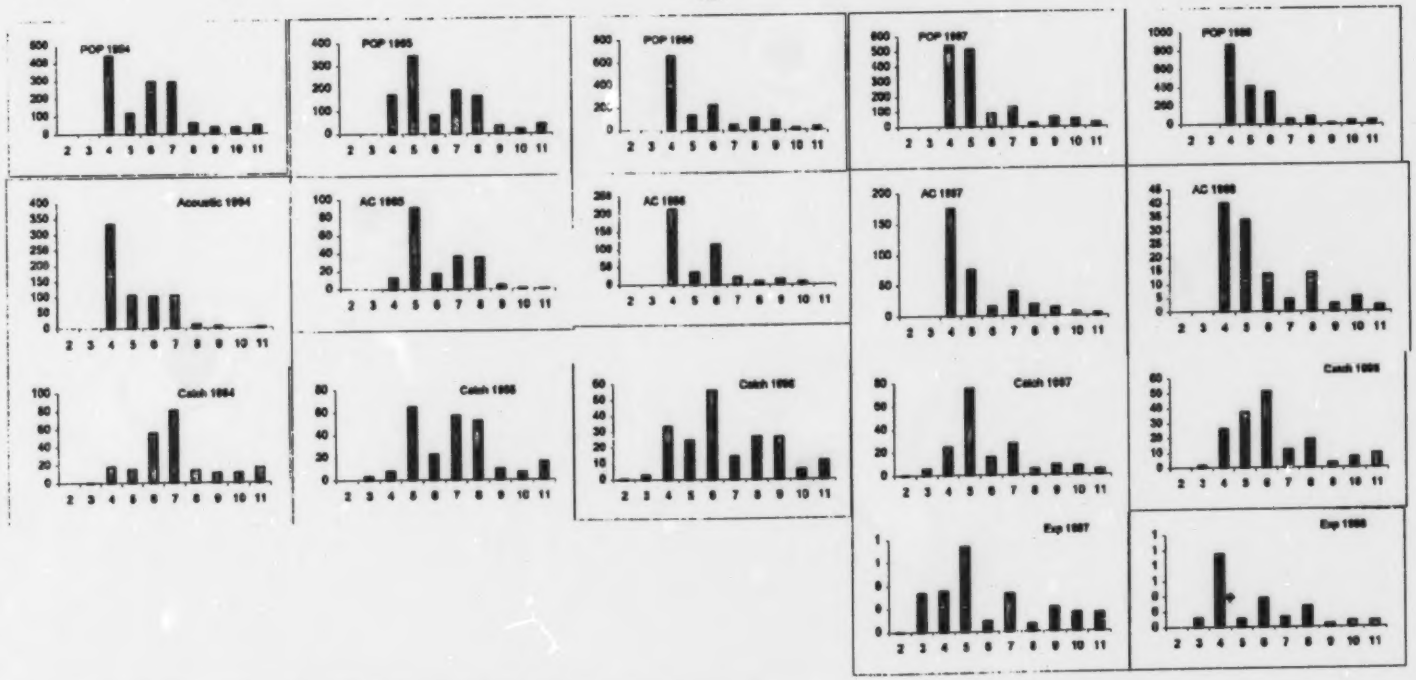


Fig. 64. Fall spawners numbers-at-age estimated from ADAPT-VPA, Acoustic survey, commercial catch, and Gulf Nova Scotia experimental nets.

Fall

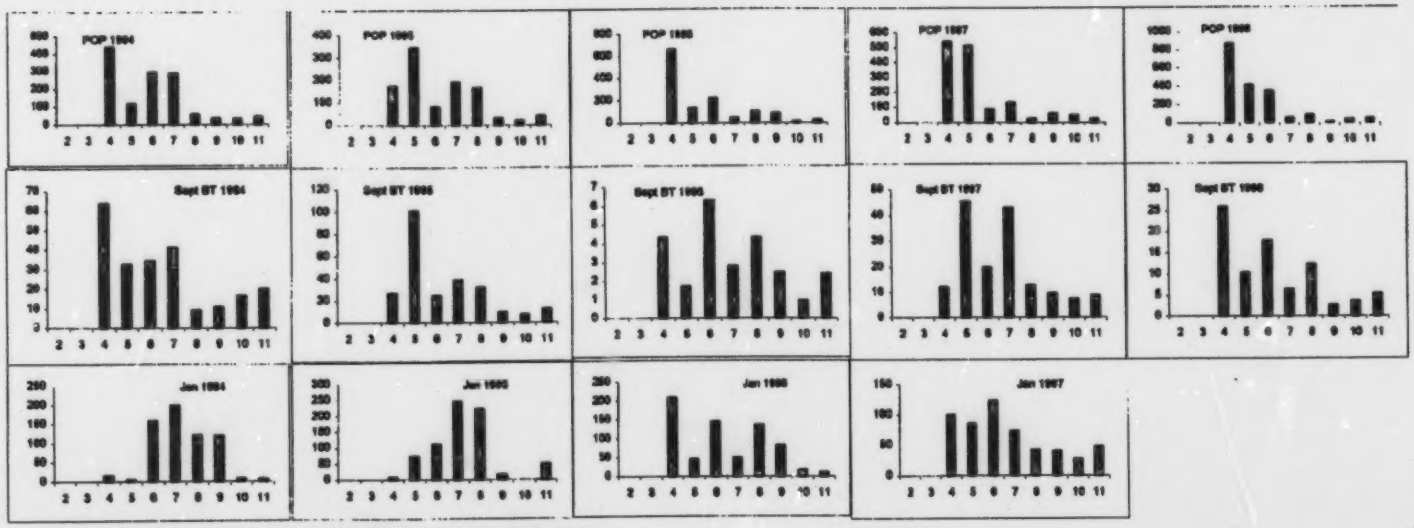


Fig. 65. Fall spawner numbers-at-age estimated from ADAPT-VPA, September, and January bottom trawl surveys.

Fall Spawners
Projection Comparisons

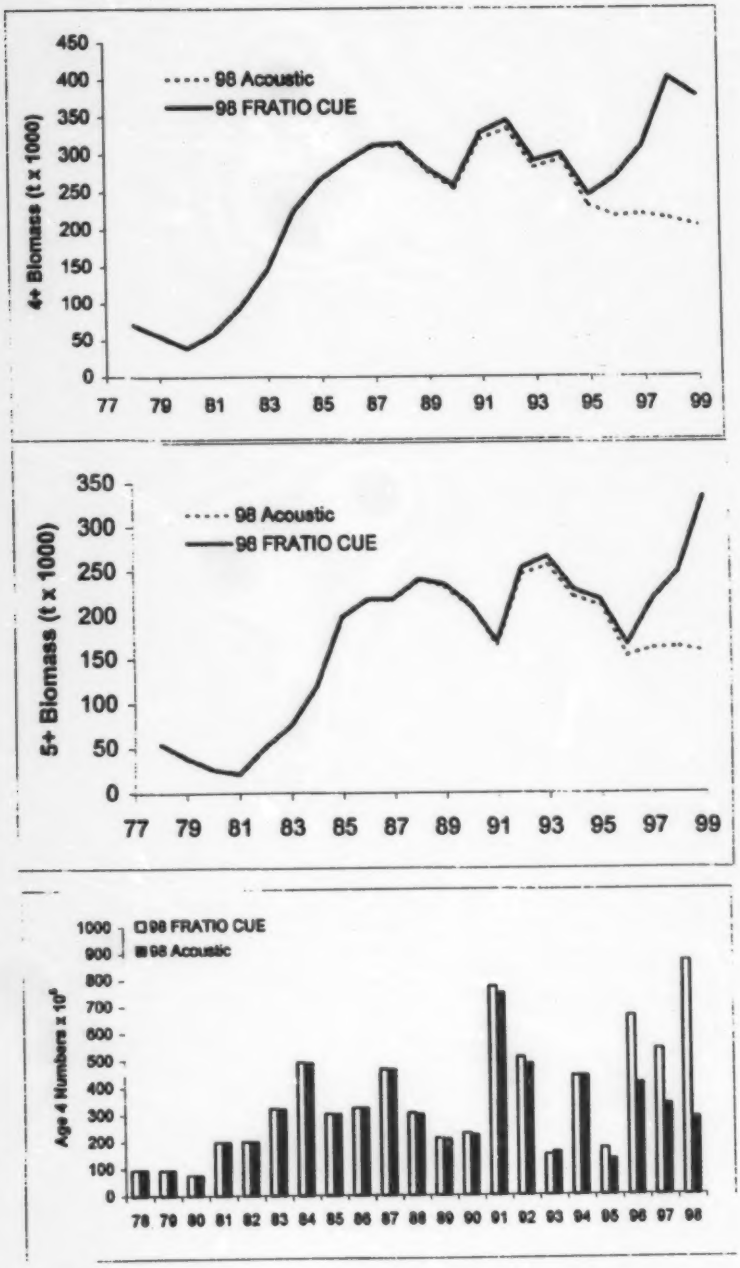
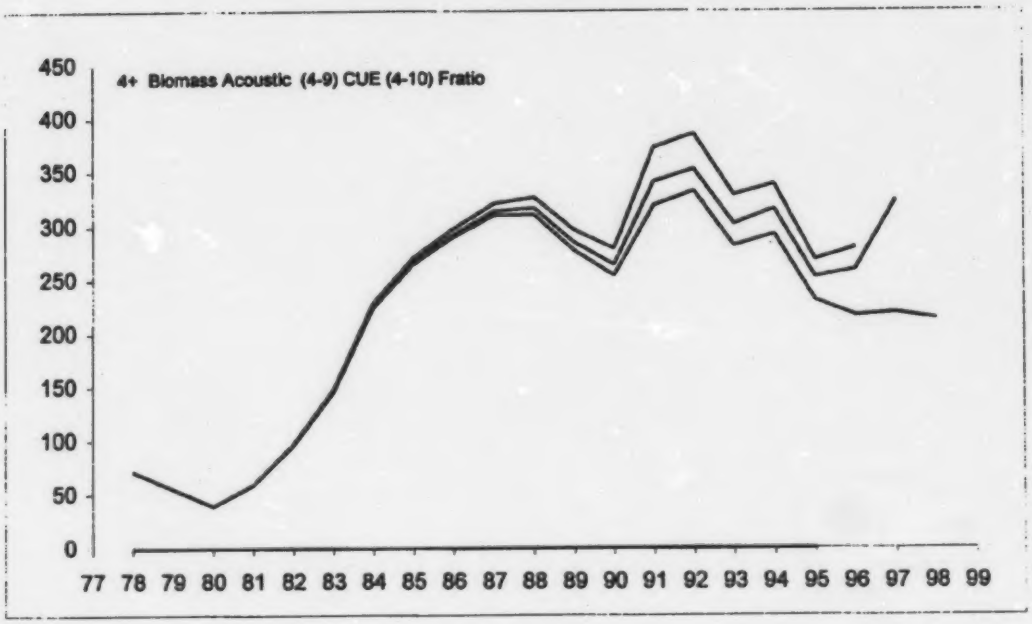


Fig. 66. Fall spawner biomass and age 4 numbers using ADAPT-VPA FRATIO model with split CUE and split CUE combined with acoustic index.

Fall Spawners - Acoustic 4-9, CUE 4-10 FRATIO



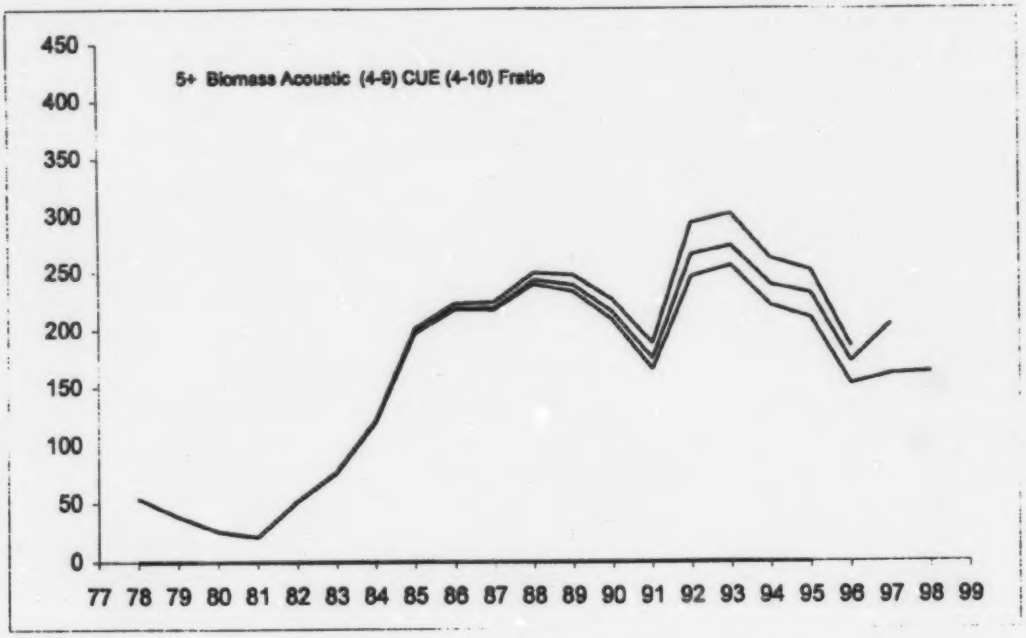


Fig. 67. Fall spawner retrospective analysis of ADAPT-VPA FRATIO model combining acoustic and split CUE indices.

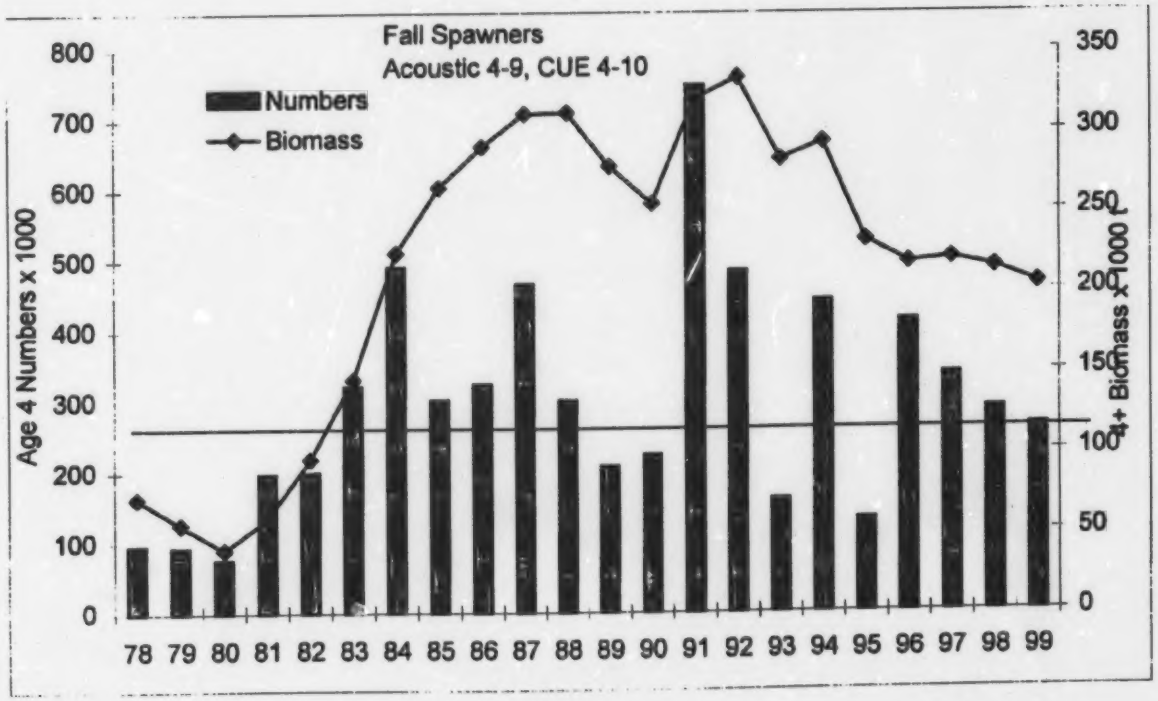


Fig. 69. Fall spawner age 4 numbers, 4+ biomass, and average numbers of age 4 (horizontal line) for ADAPT-VPA FRATIO model using acoustic index.

Appendix 1a. Herring biomass and density estimated from the acoustic survey in the southern Gulf of St. Lawernce. See Tables 37, 38 for areas included in estimates for each year. Night hours are defined as 1900 to 0700.

Year and Dates	Area	Number of Transects	Mean Density (kg/m^2)	Estimated Biomass (t/area)	CV	Proportion surveyed at night
1998	CHALEUR-MISCOU	151	0.0346	146831	0.15	1
Sept. 19 to	PEI	0	–	–	–	–
10-Oct	CAPE BRETON INSHORE	52	0.0305	43933	0.17	1
	1998 TOTAL	203	0.0335	190764	0.12	1
1997	CHALEUR-MISCOU	156	0.0285	193656	0.27	1
Sept. 21 to	PEI-MAGDELEN ISLANDS	64	0.0109	70373	0.09	1
11-Oct	CAPE BRETON INSHORE	42	0.0158	17463	0.38	1
	1997 TOTAL	262	0.0196	281492	0.19	1
1996	CHALEUR-MISCOU INSHORE	142	0.0494	241992	0.16	1
Sept 24-	CHALEUR-MISCOU OFFSHORE	36	0.0052	15090	0.28	1
16-Oct	PEI-PICTOU-GEORGES	55	0.0128	62846	0.19	1
	CAPE BRETON INSHORE	28	0.0260	21869	0.19	1
	1996 TOTAL	261	0.0252	341797	0.12	1
1995	CHALEUR-MISCOU INSHORE	98	0.0181	62229	0.22	1
Sept 23-	CHALEUR-MISCOU OFFSHORE	18	0.0058	9156	0.2	1
8-Oct	MILNE - GEORGES	21	0.0083	10564	–	1
	CAPE BRETON INSHORE	35	0.0066	7295	0.5	1
	1995 TOTAL	172	0.0121	89244	0.16	1
@ 1994	CHALEUR-MISCOU INSHORE	106	0.0415	162585	0.11	1
Oct 16-28	CHALEUR-MISCOU OFFSHORE	27	0.0063	16838	0.34	1
	CAPE BRETON INSHORE	0	–	–	–	–
	1994 TOTAL	133	0.0272	179423	0.1	1
1993	CHALEUR-MISCOU INSHORE	163	0.0202	114052	0.35	0.93
Oct 2-20	CHALEUR-MISCOU OFFSHORE	45	0.001	4284	0.41	0
	CAPE BRETON INSHORE	91	0.0039	7945	0.23	0.68
	CAPE BRETON OFFSHORE	39	0.0019	4567	0.41	0.09
	1993 TOTAL	338	–	130848	0.31	0.85
1992	CHALEUR-MISCOU INSHORE	216	0.0207	48258	0.1	0.65
Oct 1-22	CHALEUR-MISCOU OFFSHORE	102	0.0078	96582	0.52	0.75
	CAPE BRETON INSHORE	78	0.0227	44762	0.25	0.85
	CAPE BRETON OFFSHORE	22	0.0008	83	0.69	0
	1992 TOTAL	418	–	189685	0.29	0.75
1991	CHALEUR-MISCOU INSHORE	158	0.0054	16724	0.46	0.87
Oct 10-24	CHALEUR-MISCOU OFFSHORE	50	0.0015	23214	0.55	0.65
	CAPE BRETON INSHORE	49	0.0026	4418	0.32	0.98
	1991 TOTAL	257	–	44356	0.33	0.75

Appendix 1b. Acoustic survey stratum and area herring biomass densities and estimates.

Area and Stratum	Average TS (dB/kg)	Stratum Area (km^2)	Weighted Mean Sa (dB/m^2)	Biomass Density (kg/m^2)	Biomass index per Stratum Total (tons)	SE (tons)	SE % of Total
CHALEUR-MISCOU							
PTE_SECHE	-35.4	65.9	-45.0	0.1107	7298	4881	67
RIV_RENARD	-35.4	124.6	-42.2	0.2108	26275	16717	64
CAP_BON_AMI	-35.4	54.9	-53.5	0.0157	859	622	72
GASPE_OFF	-35.4	75.0	-61.0	0.0028	208	106	51
LA_MALBAIE	-35.8	95.6	-65.1	0.0012	113	71	63
ANSE_BEAUFILS	-35.8	96.0	-54.5	0.0136	1307	1099	84
GDE_RIVIERE	-35.8	86.9	-45.4	0.1097	9533	2165	23
NEWPORT	-34.6	187.0	-62.2	0.0018	329	287	87
SHIGAWAKE	-34.7	323.3	-46.1	0.0735	23749	6397	27
NEW_CARLISLE	-34.3	167.0	-54.4	0.0098	1629	632	39
NEW_RICHMOND	-32.4	253.6	-50.2	0.0164	4152	1555	37
BELLEDUNE	-32.4	348.0	-53.7	0.0074	2579	751	29
NEPISIGUIT	-35.3	278.0	-49.4	0.0388	10780	4190	39
MAISONNETTE	-35.4	137.5	-50.2	0.0332	4564	599	13
WEST_MISCOU	-35	177.0	-45.2	0.0959	16966	3034	18
NORTH_MISCOU	-34.7	208.9	-47.7	0.0501	10456	5690	54
MISCOU_NW	-34.7	524.0	-51.1	0.0228	11960	4004	33
MISCOU_NE	-34.7	262.0	-50.8	0.0245	6413	3723	58
MISCOU_SE	-34.7	262.0	-51.1	0.0229	5993	3415	57
MISCOU_SW	-34.7	524.0	-59.6	0.0032	1668	802	48
TOTAL		**4251.3**			**146831**		
MEAN				**0.0346**		**21346**	
					C.V.	**0.15**	
CAPE BRETON							
MARGAREE	-35.3	164.0	-55.2	0.0104	1699	808	48
WHITE_CAPES	-35.3	107.0	-47.7	0.0577	6173	1503	24
PLEASANT_BAY	-35.3	140.7	-47.4	0.0620	8717	6011	69
BAY_ST.LAWRENCE	-35.3	63.5	-46.4	0.0771	4893	2148	44
ASPY_BAY	-35.3	168.3	-49.3	0.0392	6600	1683	26
NEILS_HARBOUR	-35.3	171.3	-48.8	0.0442	7575	2168	29
WRECK_COVE	-35.3	59.9	-50.4	0.0304	1818	690	38
ST_ANNS_BAY	-34.6	159.0	-62.4	0.0016	260	216	83
HADDOCK_BANK	-34.6	94.9	-48.3	0.0425	4034	1427	35
SYDNEY	-34.6	168.6	-54.2	0.0109	1838	1160	63
NEW_WATERFORD	-34.6	141.3	-60.9	0.0023	326	144	44
TOTAL		**1438.5**			**43933**		
MEAN				**0.0305**		**7424**	
					C.V.	**0.17**	

Appendix 1c. Acoustic survey Chaleur-Misccou transect backscatter and biomass density.

Stratum Date	Transect Number	Transect Length (Km)	Target Strength (dB/kg)	Average Sa (dB/m^2)	Biomass Density (Kg/m^2)	Set Number
PTE_SECHE	6	1.31	-35.4	-69.35	0.0004	
19-Sep	7	3.36	-35.4	-42.13	0.2125	
	8	3.08	-35.4	-86.67	0.0000	
	9	2.54	-35.4	-48.39	0.0502	
	10	1.73	-35.4	-1009.36	0.0000	
	11	1.45	-35.4	-38.88	0.4485	
RIV_RENARD	12	2.71	-35.4	-94.83	0.0000	
19-Sep	13	2.19	-35.4	-1010.39	0.0000	
	14	2.49	-35.4	-54.35	0.0127	
	15	2.59	-35.4	-34.88	1.1269	
	16	3.34	-35.4	-40.25	0.3277	
	18	3.58	-35.4	-44.07	0.1360	
	19	4.07	-35.4	-43.30	0.1622	
	21	5.34	-35.4	-47.21	0.0659	
CAP_BON_AMI	22	2.79	-35.4	-48.40	0.0501	
20-Sep	24	5.60	-35.4	-58.82	0.0046	
	25	3.80	-35.4	-52.10	0.0214	
	26	3.56	-35.4	-1012.50	0.0000	
GASPE_OFF	27	5.52	-35.4	-63.25	0.0016	
20-Sep	28	6.98	-35.4	-62.64	0.0019	
	29	8.70	-35.4	-1016.38	0.0000	
	31	9.54	-35.4	-57.21	0.0066	
LA_MALBAIE	32	3.52	-35.81	-61.27	0.0028	
20-Sep	34	10.42	-35.81	-62.29	0.0022	
	35	8.50	-35.81	-1016.29	0.0000	
	36	5.93	-35.81	-1014.72	0.0000	
ANSE_BEAUFILS	37	2.56	-35.81	-1011.06	0.0000	
20-Sep	38	7.46	-35.81	-1015.72	0.0000	
	40	5.92	-35.81	-49.09	0.0471	
	41	6.63	-35.81	-59.47	0.0043	
GRANDE_RIVIERE	42	5.06	-35.81	-47.32	0.0707	
21-Sep	43	5.54	-35.81	-47.65	0.0655	
	44	5.43	-35.81	-46.59	0.0835	
	45	4.88	-35.81	-41.69	0.2581	48
	46	4.42	-35.81	-48.58	0.0529	
	47	3.63	-35.81	-43.42	0.1736	
	48	3.64	-35.81	-45.05	0.1192	12
	49	4.43	-35.81	-47.08	0.0747	13
NEWPORT	50	7.49	-34.61	-54.87	0.0094	
21-Sep	51	9.15	-34.61	-1016.61	0.0000	
	52	8.44	-34.61	-63.74	0.0012	
	53	7.89	-34.61	-1015.96	0.0000	
	54	7.61	-34.61	-73.38	0.0001	
	55	5.90	-34.61	-1014.70	0.0000	
SHIGAWAKE	56	7.93	-34.72	-1015.98	0.0000	8
22-Sep	57	8.50	-34.72	-64.88	0.0010	9
	58	8.88	-34.72	-49.35	0.0345	11
	59	9.95	-34.72	-47.63	0.0512	14
SHIGAWAKE	60	7.57	-34.72	-43.70	0.1266	15
22-Sep	61	7.18	-34.72	-44.79	0.0985	18
	62	7.69	-34.72	-42.47	0.1678	19
	63	6.89	-34.72	-48.88	0.0384	20
	64	6.87	-34.72	-44.90	0.0961	25
	65	4.95	-34.72	-39.57	0.3278	21
	66	6.20	-34.72	-47.65	0.0510	22
	67	4.46	-34.72	-48.49	0.0420	24
	68	5.95	-34.72	-47.46	0.0532	46
	69	6.80	-34.72	-47.07	0.0583	47
	70	6.78	-34.72	-46.39	0.0681	49
	71	6.25	-34.72	-48.14	0.0455	

Appendix 1c (cont.)

Stratum Date	Transect Number	Transect Length (Km)	Target Strength (dB/kg)	Average Sa (dB/m²)	Biomass Density (Kg/m²)	Set Number
NEW_CARLISLE	72	8.87	-34.3	-84.33	0.0000	
23-Sep	73	6.31	-34.3	-52.85	0.0140	10
	75	5.83	-34.3	-55.34	0.0079	16
	76	5.88	-34.3	-61.10	0.0021	
	77	5.30	-34.3	-50.72	0.0228	17
	78	4.81	-34.3	-51.43	0.0194	23
NEW_RICHMOND	79	5.99	-32.37	-52.36	0.0100	
23-Sep	80	5.96	-32.37	-49.71	0.0184	
	81	6.35	-32.37	-49.27	0.0204	
	82	5.41	-32.37	-45.64	0.0471	26
	83	8.94	-32.37	-53.37	0.0079	
	84	10.09	-32.37	-53.70	0.0074	
BELLEDUNE	85	1.48	-32.37	-54.14	0.0067	
24-Sep	86	6.30	-32.37	-54.62	0.0060	
	87	4.37	-32.37	-55.74	0.0046	
	88	4.18	-32.37	-54.06	0.0068	
	89	4.91	-32.37	-48.26	0.0257	28
	90	6.10	-32.37	-55.38	0.0050	
	91	6.62	-32.37	-60.93	0.0014	
	92	6.65	-32.37	-57.39	0.0031	
	94	8.51	-32.37	-54.63	0.0059	
	95	9.65	-32.37	-52.11	0.0106	27
NEPISIGUIT	97	7.92	-35.3	-1015.98	0.0000	
25-Sep	98	8.55	-35.3	-69.45	0.0004	
	99	8.68	-35.3	-53.26	0.0160	
	100	8.59	-35.3	-53.61	0.0148	
	102	11.00	-35.3	-51.68	0.0230	29
	103	11.19	-35.3	-52.25	0.0202	
	105	10.09	-35.3	-48.68	0.0460	30
	107	8.44	-35.3	-56.60	0.0074	
	108	6.83	-35.3	-46.01	0.0851	31
	109	6.68	-35.3	-42.34	0.1980	34
	110	6.42	-35.3	-46.03	0.0846	35
	111	6.42	-35.3	-48.58	0.0470	36
	112	6.18	-35.3	-52.25	0.0202	
MAISONNETTE	113	4.36	-35.38	-49.14	0.0422	32
26-Sep	114	4.87	-35.38	-50.88	0.0282	
	115	4.25	-35.38	-52.14	0.0211	33
	116	3.93	-35.38	-54.85	0.0113	
	117	4.62	-35.38	-54.69	0.0117	
	118	4.56	-35.38	-52.25	0.0206	38
	119	5.44	-35.38	-57.11	0.0067	
	120	5.56	-35.38	-49.34	0.0403	37
	121	5.72	-35.38	-51.40	0.0250	
	122	5.64	-35.38	-50.02	0.0344	1
	124	5.07	-35.38	-49.43	0.0394	
	125	5.85	-35.38	-54.17	0.0132	
	126	6.26	-35.38	-51.14	0.0266	2
	127	7.79	-35.38	-46.91	0.0703	39
	129	8.34	-35.38	-49.43	0.0394	40
	130	8.54	-35.38	-47.77	0.0578	41
WEST_MISCOU	131	7.25	-35.04	-46.65	0.0689	
26-Sep	133	3.84	-35.04	-42.85	0.1654	42
	135	6.51	-35.04	-44.28	0.1190	43
	137	8.75	-35.04	-48.49	0.0452	
	139	3.92	-35.04	-48.02	0.0503	
	140	5.13	-35.04	-46.46	0.0720	
	141	5.82	-35.04	-44.52	0.1127	44
	142	5.20	-35.04	-42.16	0.1939	45
	143	6.27	-35.04	-45.90	0.0821	

Appendix 1c (cont.)

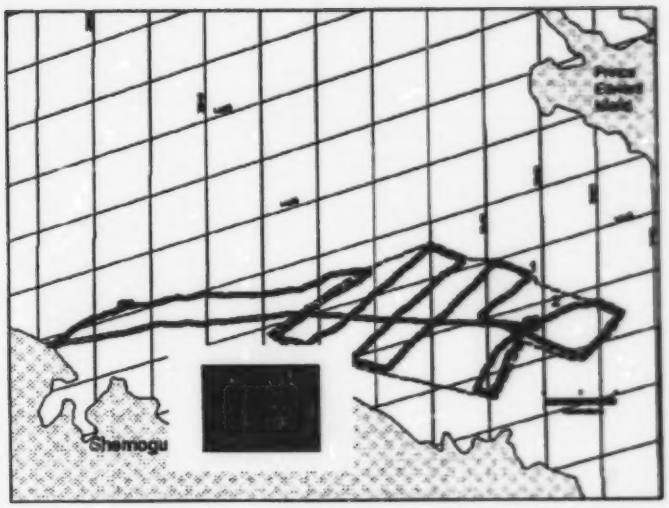
Stratum Date	Transect Number	Transect Length (Km)	Target Strength (dB/kg)	Average Sa (dB/m²)	Biomass Density (Kg/m²)	Set Number
NORTH_MISCOU	144	5.37	-34.65	-44.68	0.0995	
27-Sep	145	3.83	-34.65	-40.67	0.2502	50
	146	3.24	-34.65	-41.57	0.2034	51
	147	6.02	-34.65	-43.41	0.1332	52
	148	6.21	-34.65	-47.71	0.0495	
	149	7.37	-34.65	-67.09	0.0006	
	150	7.20	-34.65	-1015.56	0.0000	
	151	9.17	-34.65	-53.74	0.0123	
	152	9.11	-34.65	-53.52	0.0130	
	153	7.15	-34.65	-1015.53	0.0000	
	154	5.20	-34.65	-1014.15	0.0000	
MISCOU_NW	155	12.47	-34.65	-1017.95	0.0000	
28-Sep	158	12.93	-34.65	-1018.10	0.0000	
	160	12.58	-34.65	-50.42	0.0265	
	161	12.52	-34.65	-48.74	0.0391	
	163	13.01	-34.65	-49.40	0.0336	
	164	12.74	-34.65	-53.34	0.0135	
	167	12.72	-34.65	-55.09	0.0090	
	169	12.25	-34.65	-46.71	0.0623	
MISCOU_NE	156	6.84	-34.65	-1015.34	0.0000	
29-Sep	157	5.76	-34.65	-1014.59	0.0000	
	165	6.17	-34.65	-47.14	0.0564	
	166	6.36	-34.65	-46.73	0.0620	
	170	6.27	-34.65	-58.46	0.0042	
MISCOU_SE	173	5.96	-34.65	-56.65	0.0063	
1-Oct	176	6.42	-34.65	-53.25	0.0138	
	178	6.09	-34.65	-47.79	0.0486	
MISCOU_SW	172	12.28	-34.65	-63.07	0.0014	
30-Sep	174	12.63	-34.65	-55.84	0.0076	
	175	12.60	-34.65	-60.14	0.0028	
	179	12.95	-34.65	-65.27	0.0009	

Aopendix 1d. Acoustic survey Cape Breton transect backscatter and biomass density.

Stratum Date	Transect Number	Transect Length (Km)	Target Strength (dB/kg)	Average Sa (dB/m^2)	Biomass Density (Kg/m^2)	Set Number
MARGAREE	221	2.84	-35.31	-50.32	0.0315	53
7-Oct	222	5.32	-35.31	-59.09	0.0042	
	223	5.54	-35.31	-54.42	0.0123	
	224	6.82	-35.31	-57.22	0.0064	
	227	5.53	-35.31	-56.09	0.0083	
WHITE_CAPES	229	5.88	-35.31	-49.28	0.0401	
7-Oct	230	6.00	-35.31	-45.90	0.0874	
	231	4.84	-35.31	-45.74	0.0906	
	232	4.22	-35.31	-50.38	0.0311	
	234	3.83	-35.31	-51.15	0.0261	
PLEASANT_BAY	235	6.02	-35.31	-41.83	0.2230	54
8-Oct	237	5.93	-35.31	-48.58	0.0471	
	238	6.66	-35.31	-57.39	0.0062	
	239	5.13	-35.31	-62.25	0.0020	
	240	3.26	-35.31	-74.70	0.0001	
BAY_ST.LAWRENCE	242	4.85	-35.27	-44.98	0.1069	
8-Oct	243	7.14	-35.27	-49.44	0.0383	
	244	7.52	-35.27	-49.93	0.0342	
	245	4.52	-35.27	-42.78	0.1775	55
ASPY_BAY	248	2.59	-35.27	-47.16	0.0648	
8-Oct	249	7.93	-35.27	-51.03	0.0266	
	250	10.01	-35.27	-47.37	0.0617	
	251	10.12	-35.27	-47.01	0.0671	56
	252	10.30	-35.27	-49.43	0.0384	
	253	8.94	-35.27	-57.05	0.0066	
	254	5.37	-35.27	-56.88	0.0069	
NEILS_HARBOUR	255	5.41	-35.27	-62.62	0.0018	
9-Oct	257	6.01	-35.27	-46.98	0.0675	57
	258	6.05	-35.27	-52.27	0.0199	
	259	8.08	-35.27	-47.49	0.0599	
	260	11.28	-35.27	-47.96	0.0539	
WRECK_COVE	262	3.36	-35.27	-48.33	0.0494	
9-Oct	263	3.73	-35.27	-46.90	0.0686	
	264	4.47	-35.27	-50.19	0.0322	
	265	5.16	-35.27	-55.00	0.0106	
	266	5.14	-35.27	-56.11	0.0082	
ST_ANNS_BAY	267	8.88	-34.56	-57.20	0.0054	
9-Oct	268	6.48	-34.56	-1015.11	0.0000	
	269	6.83	-34.56	-1015.33	0.0000	
	270	7.33	-34.56	-1015.64	0.0000	
HADDOCK_BANK	271	12.68	-34.56	-55.39	0.0083	
9-Oct	272	10.03	-34.56	-45.63	0.0782	58
	273	8.16	-34.56	-49.02	0.0358	
	274	8.27	-34.56	-46.90	0.0584	
SYDNEY	276	7.82	-34.56	-50.75	0.0241	
10-Oct	277	9.34	-34.56	-50.84	0.0236	
	279	10.45	-34.56	-101.05	0.0000	
	280	9.85	-34.56	-1016.92	0.0000	
NEW_WATERFORD	282	7.34	-34.56	-1015.65	0.0000	
10-Oct	283	7.31	-34.56	-62.81	0.0015	
	284	7.71	-34.56	-59.64	0.0031	
	285	6.83	-34.56	-57.80	0.0047	

Appendix 1e. Acoustic survey Chaleur – Miscou same strata comparison of transect length surveyed, proportion with herring backscatter detected and resulting biomass estimates.

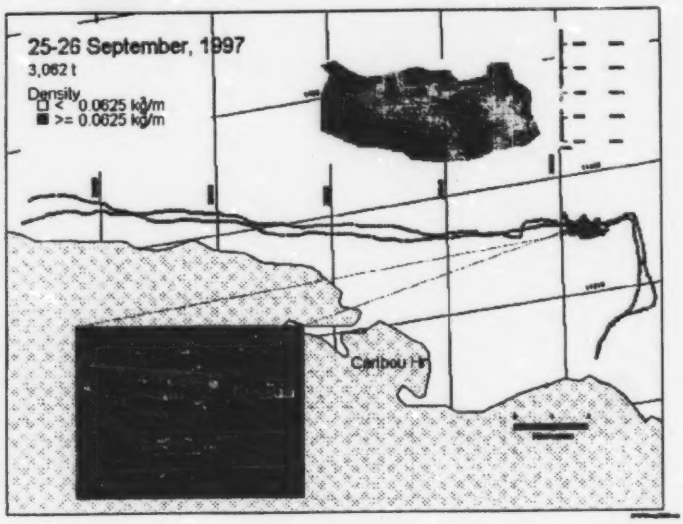
Stratum Name	Transect Length surveyed per stratum (km)				
	1998	1997	1996	1995	1994
Grande Riviere	37.0	58.2	74.8	64.5	61.4
Newport	46.5	51.8	79.2	72.5	85.6
Shigawake	112.9	120.0	128.9	123.0	100.2
New Carlilse	37.0	44.3	52.4	57.1	68.5
New Richmond	42.7	32.0	37.2	42.0	84.5
Belledune	58.8	37.3	35.4	40.1	53.4
Nepisiguit	107.0	58.8	82.7	79.4	66.3
Maisonnette	90.9	70.2	68.3	73.9	69.6
E Miscou NW	101.2	100.0	89.1	50.6	76.0
E Miscou NE	31.4	64.6	63.2	91.3	78.3
E Miscou SW	50.4	88.2	90.9	88.2	61.7
E Miscou SE	18.5	64.1	63.1	75.7	50.5
Total Distance Surveyed (km)	734.1	789.5	865.2	858.3	856.1
Distance with backscatter (km)	145.0	82.4	140.0	92.9	136.6
Total Biomass index (t)	83349	171830	163195	63676	159983
Percent of Total Distance Surveyed with bacscatter	19.8	10.4	16.2	10.8	16.0



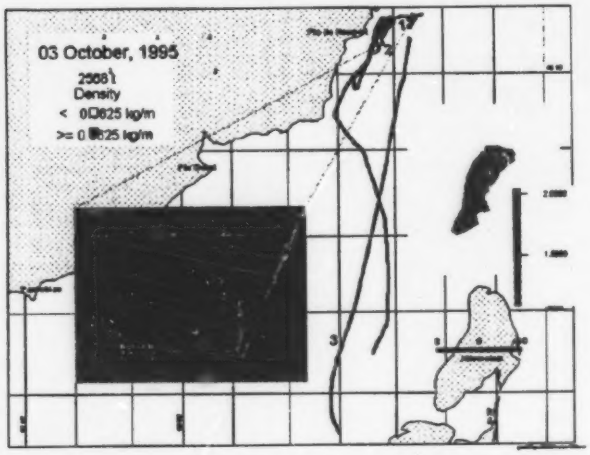
Appendix 2a. Example of survey map for southeast New Brunswick spring projects.

Appendix 2b. Biomass estimates from spring spawner surveys done by inshore fishing vessel in southeast New Brunswick, 1998.

Month	Day	Area (km2)	Number of Transects	Biomass Estimate	Standard Error
April	30	138	9	660	433
May	3	114	8	34	22
May	13	134	11	105	65
May	19	142	8	49	42
June	8	93	7	1127	712
June	12	52	5	342	254
June	18	43	5	62	50



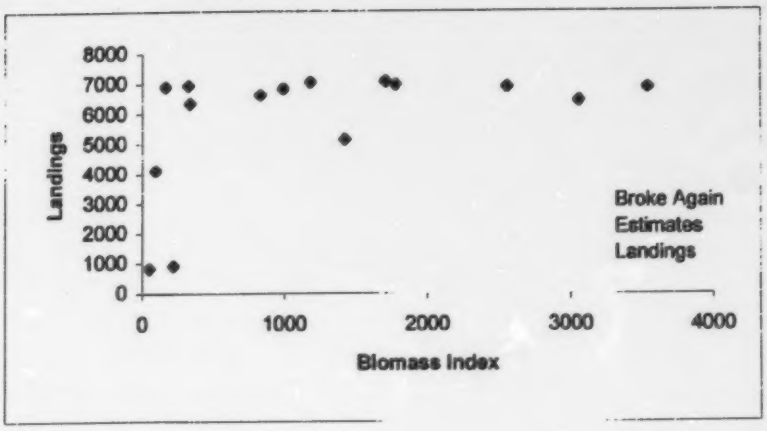
Appendix 3a. Map of typical data collected by boat with FEMTO – HDPS system recording data while fishing during southern Gulf of St. Lawrence Nova Scotia fall herring fishery.

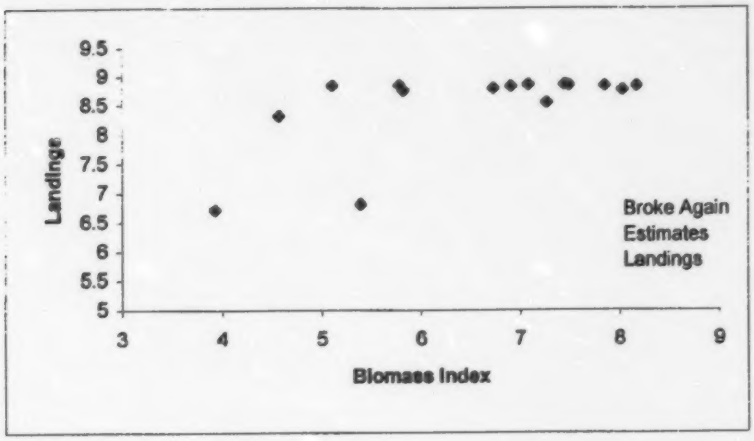


Appendix 3b. Map of typical data collected by herring purse seiner with FEMTO – HDPS system recording data while fishing during southern Gulf of St. Lawrence Chaleur Bay fall herring fishery.

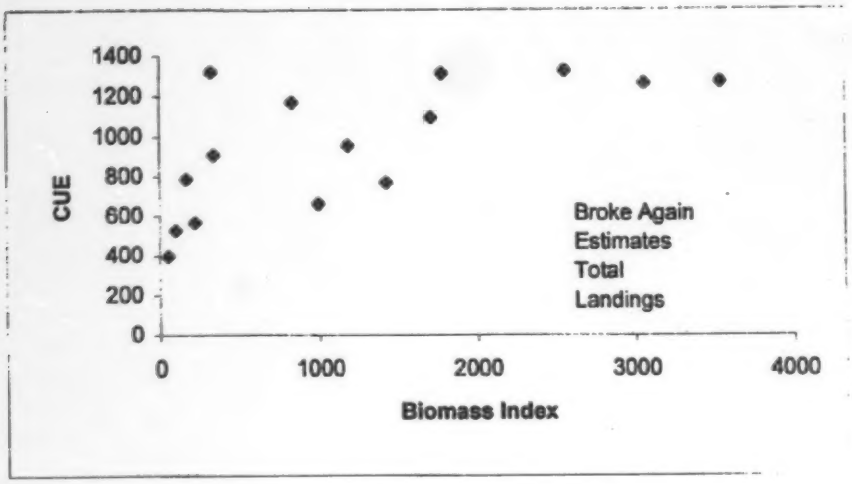
Appendix 3c. Estimates using arithmetic average of all points in school compared to estimates obtained using kriging (for all dates) and inverse distance weighting (IDW) and natural neighbor analysis (NN) (for two days). Data comes from a single inshore boat collecting data in the southern Gulf of St. Lawrence Nova Scotia fall herring fishery using a Femto HDPS system. An ne indicates no estimate for those days.

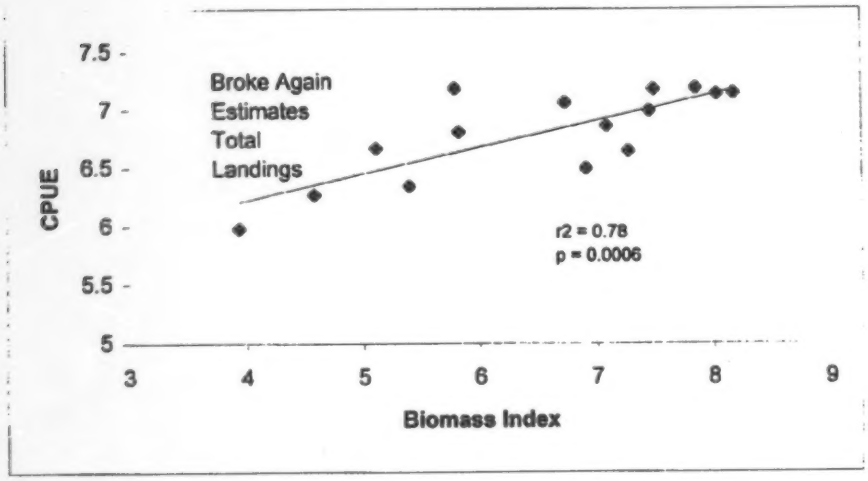
	Estimates				Landings	
Day	Arithmetic	Kriging	IDW	NN	Acoustic Boat	Total Fleet
7-Sep	2299	1429	1261	1421	5144	218943
8-Sep	79	51	47	45	827	100704
9-Sep	187	166			6904	159896
10-Sep	296	220			907	75170
11-Sep	404	338			6348	100566
14-Sep	ne	ne			4534	166843
16-Sep	ne	ne				197877
16-Sep	1070	996			6824	122290
17-Sep	1285	1187			7027	536711
19-Sep	92	97			4115	62958
22-Sep	345	834			6618	736133
23-Sep	1472	1713			7058	463635
25-Sep	3905	3543			6864	508077
25-Sep	3668	3062			6428	766805
28-Sep	1908	1782			6960	761208
29-Sep	452	326			6935	432364
30-Sep	2690	2560			6887	714589



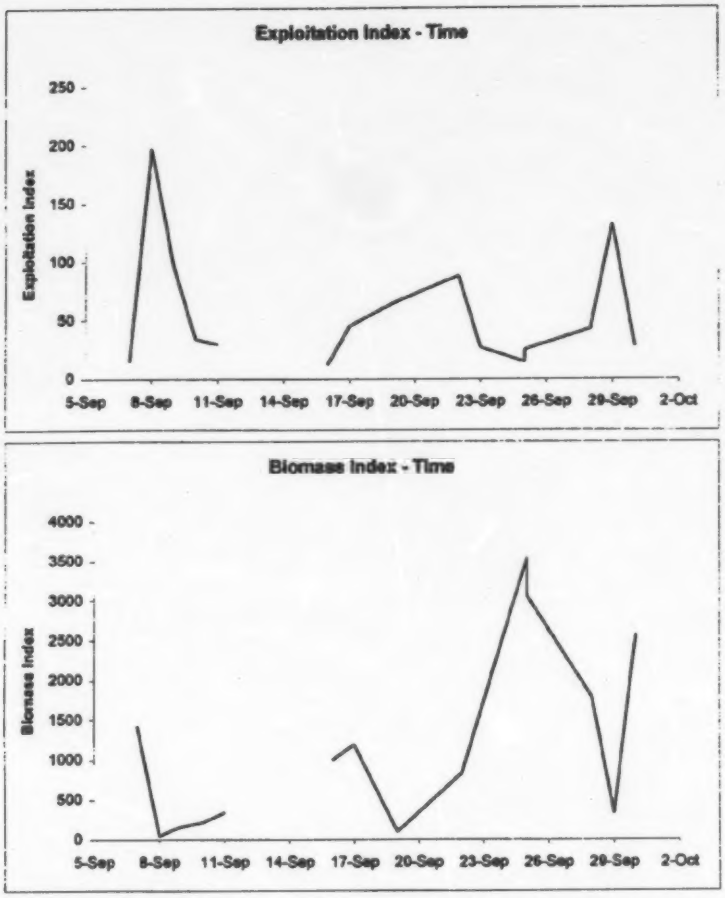


Appendix 3d. Scatterplots of landings by boat collecting acoustic data versus biomass index estimated by kriging for each day indicated in Appendix 3c. Top figure arithmetic scale, bottom figure in scale. Broke Again is the inshore boat used to collect the data.

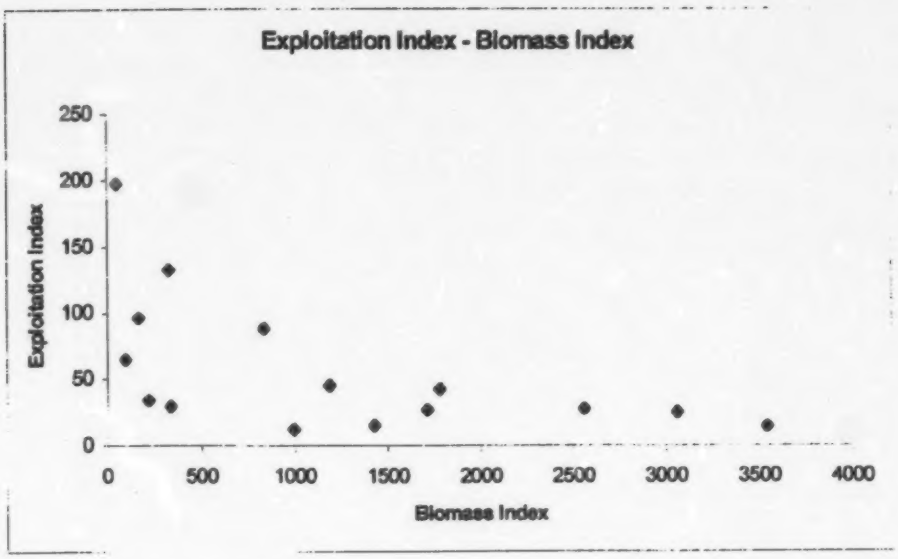


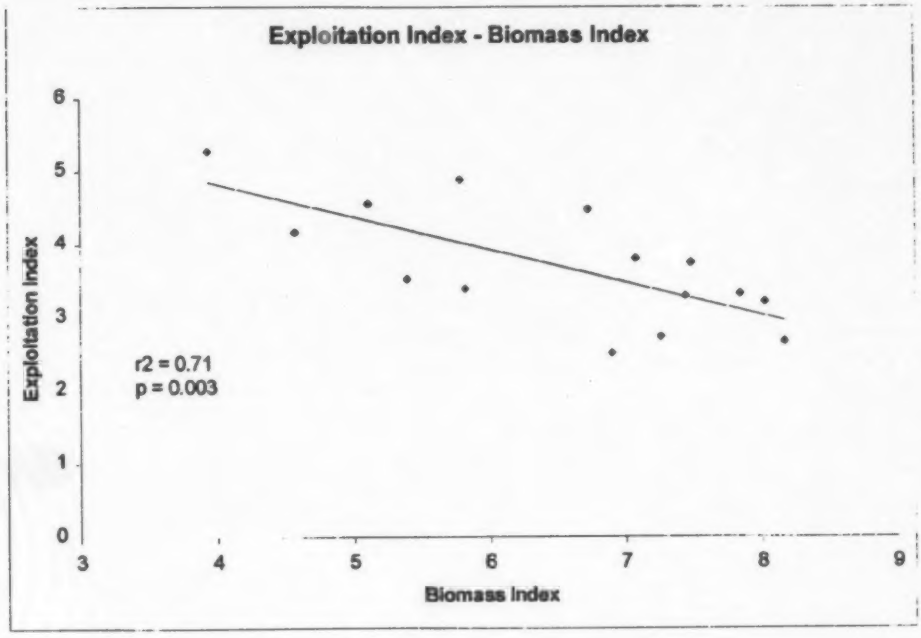


Appendix 3e. Relationship between catch rate (CPUE) from all boats participating in southern Gulf of St. Lawrence fall herring fishery and biomass indices estimated from inshore boat collecting acoustic data during the fishery. Top figure arithmetic scale, bottom figure ln scale. Broke Again is the inshore boat used to collect the data.



Appendix 3f. Exploitation rate index and biomass index trends over time in southern Gulf of St. Lawrence fall herring fishery. Exploitation rate index calculated as total landings by fleet divided by biomass index as estimated from boat recording acoustic data.





Appendix 3g. Scatterplots of exploitation index versus biomass index for southern Gulf of St. Lawrence fall herring fishery.